2017 SchweserNotes™ Part I

FRM® Exam Prep

Foundations of Risk Management

eBook 1

KAPLAN UNIVERSITY
SCHOOL OF PROFESSIONAL AND CONTINUING EDUCATION | SCHWESER

Getting Started

Part I FRM® Exam

Welcome

As the Vice President of Product Management at Kaplan Schweser, I am pleased to have the opportunity to help you prepare for the 2017 FRM® Exam. Getting an early start on your study program is important for you to sufficiently **Prepare ▸ Practice ▸ Perform®** on exam day. Proper planning will allow you to set aside enough time to master the learning objectives in the Part I curriculum.

Now that you've received your SchweserNotes™, here's how to get started:

Step 1: Access Your Online Tools

Visit **www.schweser.com/frm** and log in to your online account using the button located in the top navigation bar. After logging in, select the appropriate part and proceed to the dashboard where you can access your online products.

Step 2: Create a Study Plan

Create a study plan with the **Schweser Study Calendar** (located on the Schweser dashboard). Then view the **Candidate Resource Library** on-demand videos for an introduction to core concepts.

Step 3: Prepare and Practice

Read your SchweserNotes™

Our clear, concise study notes will help you **prepare** for the exam. At the end of each reading, you can answer the Concept Checker questions for better understanding of the curriculum.

Attend a Weekly Class

Attend our **Live Online Weekly Class** or review the on-demand archives as often as you like. Our expert faculty will guide you through the FRM curriculum with a structured approach to help you **prepare** for the exam. (See our instruction packages to the right. Visit **www.schweser.com/frm** to order.)

Practice with SchweserPro™ QBank

Maximize your retention of important concepts and **practice** answering exam-style questions in the **SchweserPro™ QBank** and taking several **Practice Exams.** Use **Schweser's QuickSheet** for continuous review on the go. (Visit **www.schweser.com/frm** to order.)

Step 4: Final Review

A few weeks before the exam, make use of our **Online Review Workshop Package.** Review key curriculum concepts in every topic, **perform** by working through demonstration problems, and **practice** your exam techniques with our 8-hour live **Online Review Workshop.** Use **Schweser's Secret Sauce®** for convenient study on the go.

Step 5: Perform

As part of our **Online Review Workshop Package**, take a **Schweser Mock Exam** to ensure you are ready to **perform** on the actual FRM Exam. Put your skills and knowledge to the test and gain confidence before the exam.

Again, thank you for trusting Kaplan Schweser with your FRM Exam preparation!

Sincerely,

Derek Burkett

Derek Burkett, CFA, FRM, CAIA
VP, Product Management, Kaplan Schweser

The Kaplan Way for Learning

PREPARE

Acquire new knowledge through demonstration and examples.

PRACTICE

Apply new knowledge through simulation and practice.

PERFORM

Evaluate mastery of new knowledge and identify achieved outcomes.

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May Exam Instructor
Dr. John Broussard
CFA, FRM

November Exam Instructor
Dr. Greg Filbeck
CFA, FRM, CAIA

*Dates, times, and instructors subject to change

Contact us for questions about your study package, upgrading your package, purchasing additional study materials, or for additional information:

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WELCOME TO THE 2017 SCHWESERNOTES

Thank you for trusting Kaplan Schweser to help you reach your goals. We are very pleased to be able to help you prepare for the Part I FRM exam. In this introduction, I want to explain the resources included with the SchweserNotes, suggest how you can best use Schweser materials to prepare for the exam, and direct you toward other educational resources you will find helpful as you study for the exam.

Besides the SchweserNotes themselves, there are many educational resources available at Schweser.com. Just log in using the individual username and password that you received when you purchased the SchweserNotes.

SchweserNotes™

The SchweserNotes™ consist of four volumes that include complete coverage of all FRM assigned topics and learning objectives, Concept Checkers (multiple-choice questions for every topic), and Self-Test questions to help you master the material and check your retention of key concepts.

Online Practice Questions

To retain what you learn, it is important that you quiz yourself often. We offer an online version of the SchweserPro™ QBank, which contains hundreds of Part I practice questions and explanations. Quizzes are available for each topic or across multiple topics. Build your own exams by specifying the topics and the number of questions.

Practice Exams

Schweser offers two full 4-hour practice exams. These exams are important tools for gaining the speed and skills you will need to pass the exam. The Practice Exams book contains answers with full explanations for self-grading and evaluation.

Schweser Study Calendar

Use your Online Access to tell us when you will start and what days of the week you can study. The online Schweser Study Calendar will create a study plan just for you, breaking the curriculum into daily and weekly tasks to keep you on track and help you monitor your study progress.

The Part I FRM exam is a formidable challenge (covering 69 assigned readings and almost 500 learning objectives), and you must devote considerable time and effort to be properly prepared. There are no shortcuts! You must learn the material, know the terminology and techniques, understand the concepts, and be able to answer 100 multiple choice questions quickly and (at least 70%) correctly. 250 hours is a good estimate of the study time required on average, but some candidates will need more or less time, depending on their individual backgrounds and experience.

To help you really master this material and be well prepared for the FRM exam, we offer several other educational resources, including:

Online Weekly Class

Our Online Weekly Class is offered each week, beginning in February for the May exam and August for the November exam. This online class brings the personal attention of a classroom into your home or office with 30 hours of real-time instruction, led by either Dr. John Paul Broussard, CFA, FRM or Dr. Greg Filbeck, CFA, FRM, CAIA. The class offers in-depth coverage of difficult concepts, instant feedback during lecture and Q&A sessions, and discussion of sample exam questions. Archived classes are available for viewing at any time throughout the season. Candidates enrolled in the Online Weekly Class also have full access to supplemental on-demand video instruction in the Candidate Resource Library and an e-mail address link for sending questions to the instructor at any time.

Late-Season Review

Late-season review and exam practice can make all the difference. Our Review Package helps you evaluate your exam readiness with products specifically designed for late-season studying. This Review Package includes: the Online Review Workshop (8-hour live and archived online review of essential curriculum topics), the Schweser Mock Exam (one 4-hour exam), and Schweser's Secret Sauce (concise summary of the FRM curriculum).

Part I Exam Weights

In preparing for the exam, you must pay attention to the weights assigned to each knowledge domain within the curriculum. The Part I exam weights are as follows:

Book	*Knowledge Domains*	*Exam Weight*	*Exam Questions*
1	Foundations of Risk Management	20%	20
2	Quantitative Analysis	20%	20
3	Financial Markets and Products	30%	30
4	Valuation and Risk Models	30%	30

How to Succeed

There are no shortcuts to studying for this exam. Expect GARP to test you in a way that will reveal how well you know the Part I curriculum. You should begin studying early and stick to your study plan. You should first read the SchweserNotes and complete the Concept Checkers for each topic. At the end of each book, you should answer the provided Self-Test questions to understand how concepts may be tested on the exam. You should finish the overall curriculum at least two weeks before the FRM exam. This will allow sufficient time for Practice Exams and further review of those topics you have not yet mastered.

I would like to take this opportunity to thank the content developers, editors, and graphic designers who worked countless hours to create the 2017 FRM SchweserNotes. I would especially like to thank Adam Stueber, CAIA; Derek Burkett, CFA, FRM, CAIA; Tim Greive, CFA; Craig Prochaska, CFA; Kent Westlund, CFA; Kurt Schuldes, CFA, CAIA; Jeff Bahr, Andy Bauer, Allie Bottcher, Katherine Bourgeois, Genevieve Kretschmer, Alyssa Brunner, Lindsey Casto, Tiffany Finstuen, Laura Goetzinger, Jared Heintz, Hannah Kelley, Alissa Knop, Gretchen Panzer, Jessica Pearse, Ashley Sinclair, Ben Strong, and Debbie White for their contributions.

Best regards,

Eric Smith

Eric Smith, CFA, FRM
FRM Product Manager
Kaplan Schweser

READING ASSIGNMENTS AND LEARNING OBJECTIVES

The following material is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by the Global Association of Risk Professionals.

READING ASSIGNMENTS

Michel Crouhy, Dan Galai, and Robert Mark, *The Essentials of Risk Management, 2nd Edition* (New York: McGraw-Hill, 2014).

1. "Risk Management: A Helicopter View," Chapter 1, including Appendix 1.1 (page 1)

2. "Corporate Risk Management: A Primer," Chapter 2 (page 15)

3. "Corporate Governance and Risk Management," Chapter 4 (page 27)

James Lam, *Enterprise Risk Management: From Incentives to Controls, 2nd Edition* (Hoboken, NJ: John Wiley & Sons, 2014).

4. "What is ERM?," Chapter 4 (page 37)

5. René Stulz, "Risk Management, Governance, Culture, and Risk Taking in Banks," FRBNY Economic Policy Review (August 2016): 43–59. (page 47)

Steve Allen, *Financial Risk Management: A Practitioner's Guide to Managing Market and Credit Risk, 2nd Edition* (New York: John Wiley & Sons, 2013).

6. "Financial Disasters," Chapter 4 (page 59)

7. Markus K. Brunnermeier, 2009. "Deciphering the Liquidity and Credit Crunch 2007–2008," Journal of Economic Perspectives 23:1, 77–100. (page 76)

8. Gary Gorton and Andrew Metrick, 2012. "Getting Up to Speed on the Financial Crisis: A One-Weekend-Reader's Guide," Journal of Economic Literature 50:1, 128–150. (page 89)

9. René Stulz, "Risk Management Failures: What are They and When Do They Happen?" Fisher College of Business Working Paper Series, October 2008. (page 101)

Edwin J. Elton, Martin J. Gruber, Stephen J. Brown and William N. Goetzmann, *Modern Portfolio Theory and Investment Analysis, 9th Edition* (Hoboken, NJ: John Wiley & Sons, 2014).

10. "The Standard Capital Asset Pricing Model," Chapter 13 (page 124)

Noel Amenc and Veronique Le Sourd, *Portfolio Theory and Performance Analysis* (West Sussex, England: John Wiley & Sons, 2003).

11. "Applying the CAPM to Performance Measurement: Single-Index Performance Measurement Indicators," Chapter 4, Section 4.2 only (page 139)

Zvi Bodie, Alex Kane, and Alan J. Marcus, *Investments, 10th Edition* (New York: McGraw-Hill, 2013).

12. "Arbitrage Pricing Theory and Multifactor Models of Risk and Return," Chapter 10 (page 149)
13. "Principles for Effective Data Aggregation and Risk Reporting," (Basel Committee on Banking Supervision Publication, January 2013). (page 163)
14. GARP Code of Conduct. (page 175)

LEARNING OBJECTIVES

1. Risk Management: A Helicopter View

After completing this reading, you should be able to:

1. Explain the concept of risk and compare risk management with risk taking. (page 1)
2. Describe the risk management process and identify problems and challenges that can arise in the risk management process. (page 2)
3. Evaluate and apply tools and procedures used to measure and manage risk, including quantitative measures, qualitative assessment, and enterprise risk management. (page 3)
4. Distinguish between expected loss and unexpected loss, and provide examples of each. (page 4)
5. Interpret the relationship between risk and reward and explain how conflicts of interest can impact risk management. (page 5)
6. Describe and differentiate between the key classes of risks, explain how each type of risk can arise, and assess the potential impact of each type of risk on an organization. (page 6)

2. Corporate Risk Management: A Primer

After completing this reading, you should be able to:

1. Evaluate some advantages and disadvantages of hedging risk exposures. (page 15)
2. Explain considerations and procedures in determining a firm's risk appetite and its business objectives. (page 17)
3. Explain how a company can determine whether to hedge specific risk factors, including the role of the board of directors and the process of mapping risks. (page 17)
4. Apply appropriate methods to hedge operational and financial risks, including pricing, foreign currency, and interest rate risk. (page 19)
5. Assess the impact of risk management instruments. (page 20)

3. Corporate Governance and Risk Management

After completing this reading, you should be able to:

1. Compare and contrast best practices in corporate governance with those of risk management. (page 27)
2. Assess the role and responsibilities of the board of directors in risk governance. (page 29)
3. Evaluate the relationship between a firm's risk appetite and its business strategy, including the role of incentives. (page 31)
4. Distinguish the different mechanisms for transmitting risk governance throughout an organization. (page 29)
5. Illustrate the interdependence of functional units within a firm as it relates to risk management. (page 31)
6. Assess the role and responsibilities of a firm's audit committee. (page 30)

4. What is ERM?

After completing this reading, you should be able to:
1. Describe enterprise risk management (ERM) and compare and contrast differing definitions of ERM. (page 37)
2. Compare the benefits and costs of ERM and describe the motivations for a firm to adopt an ERM initiative. (page 38)
3. Describe the role and responsibilities of a chief risk officer (CRO) and assess how the CRO should interact with other senior management. (page 40)
4. Distinguish between components of an ERM program. (page 41)

5. Risk Management, Governance, Culture, and Risk Taking in Banks

After completing this reading, you should be able to:
1. Assess methods that banks can use to determine their optimal level of risk exposure, and explain how the optimal level of risk can differ across banks. (page 47)
2. Describe implications for a bank if it takes too little or too much risk compared to its optimal level. (page 48)
3. Explain ways in which risk management can add or destroy value for a bank. (page 48)
4. Describe structural challenges and limitations to effective risk management, including the use of VaR in setting limits. (page 49)
5. Assess the potential impact of a bank's governance, incentive structure, and risk culture on its risk profile and its performance. (page 51)

6. Financial Disasters

After completing this reading, you should be able to:
1. Analyze the key factors that led to and derive the lessons learned from the following risk management case studies:
    - Chase Manhattan and their involvement with Drysdale Securities
    - Kidder Peabody
    - Barings
    - Allied Irish Bank
    - Union Bank of Switzerland (UBS)
    - Société Générale
    - Long Term Capital Management (LTCM)
    - Metallgesellschaft
    - Bankers Trust
    - JPMorgan, Citigroup, and Enron (page 59)

7. Deciphering the Liquidity and Credit Crunch 2007–2008

After completing this reading, you should be able to:
1. Describe the key factors the led to the housing bubble. (page 76)
2. Explain the banking industry trends leading up to the liquidity squeeze and assess the triggers for the liquidity crisis. (page 77)
3. Explain how banks created collateralized debt obligations. (page 78)
4. Explain the purposes and uses of credit default swaps. (page 79)
5. Describe how securitized and structured products were used by investor groups and describe the consequences of their increased use. (page 79)
6. Describe how the financial crisis triggered a series of worldwide financial and economic consequences. (page 80)

7. Distinguish between funding liquidity and market liquidity and explain how the evaporation of liquidity can lead to a financial crisis. (page 81)
8. Analyze how an increase in counterparty credit risk can generate additional funding needs and possible systemic risk. (page 83)

8. Getting Up to Speed on the Financial Crisis: A One-Weekend-Reader's Guide

After completing this reading, you should be able to:

1. Distinguish between triggers and vulnerabilities that led to the financial crisis and their contributions to the crisis. (page 89)
2. Describe the main vulnerabilities of short-term debt especially repo agreements and commercial paper. (page 89)
3. Assess the consequences of the Lehman failure on the global financial markets. (page 91)
4. Describe the historical background leading to the recent financial crisis. (page 91)
5. Distinguish between the two main panic periods of the financial crisis and describe the state of the markets during each. (page 92)
6. Assess the governmental policy responses to the financial crisis and review their short-term impact. (page 93)
7. Describe the global effects of the financial crisis on firms and the real economy. (page 95)

9. Risk Management Failures: What Are They and When Do They Happen?

After completing this reading, you should be able to:

1. Explain how a large financial loss may not necessarily be evidence of a risk management failure. (page 101)
2. Analyze and identify instances of risk management failure. (page 102)
3. Explain how risk management failures can arise in the following areas: measurement of known risk exposures, identification of risk exposures, communication of risks, and monitoring of risks. (page 102)
4. Evaluate the role of risk metrics and analyze the shortcomings of existing risk metrics. (page 104)

10. The Standard Capital Asset Pricing Model

After completing this reading, you should be able to:

1. Understand the derivation and components of the CAPM. (page 128)
2. Describe the assumptions underlying the CAPM. (page 124)
3. Interpret the capital market line. (page 125)
4. Apply the CAPM in calculating the expected return on an asset. (page 131)
5. Interpret beta and calculate the beta of a single asset or portfolio. (page 126)

11. Applying the CAPM to Performance Measurement: Single-Index Performance Measurement Indicators

After completing this reading, you should be able to:

1. Calculate, compare, and evaluate the Treynor measure, the Sharpe measure, and Jensen's alpha. (page 139)
2. Compute and interpret tracking error, the information ratio, and the Sortino ratio. (page 142)

12. Arbitrage Pricing Theory and Multifactor Models of Risk and Return

After completing this reading, you should be able to:

1. Describe the inputs, including factor betas, to a multifactor model. (page 149)
2. Calculate the expected return of an asset using a single-factor and a multifactor model. (page 150)
3. Describe properties of well-diversified portfolios and explain the impact of diversification on the residual risk of a portfolio. (page 152)
4. Explain how to construct a portfolio to hedge exposure to multiple factors. (page 154)
5. Describe and apply the Fama-French three factor model in estimating asset returns. (page 155)

13. Principles for Effective Risk Data Aggregation and Risk Reporting

After completing this reading, you should be able to:

1. Explain the potential benefits of having effective risk data aggregation and reporting. (page 163)
2. Describe key governance principles related to risk data aggregation and risk reporting practices. (page 164)
3. Identify the data architecture and IT infrastructure features that can contribute to effective risk data aggregation and risk reporting practices. (page 165)
4. Describe characteristics of a strong risk data aggregation capability and demonstrate how these characteristics interact with one another. (page 165)
5. Describe characteristics of effective risk reporting practices. (page 168)

14. GARP Code of Conduct

After completing this reading, you should be able to:

1. Describe the responsibility of each GARP member with respect to professional integrity, ethical conduct, conflicts of interest, confidentiality of information and adherence to generally accepted practices in risk management. (page 176)
2. Describe the potential consequences of violating the GARP Code of Conduct. (page 178)

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

RISK MANAGEMENT: A HELICOPTER VIEW

Topic 1

EXAM FOCUS

This is an introductory topic that provides coverage of fundamental risk management concepts that will be discussed in much more detail throughout the FRM curriculum. For the exam, it is important to understand the general risk management process and its potential shortcomings, the concept of unexpected loss, and some of the underlying points regarding the relationship between risk and reward. Also, the material on the main categories of financial and non-financial risks contains several testable concepts.

THE CONCEPT OF RISK

LO 1.1: Explain the concept of risk and compare risk management with risk taking.

Risk arises from the uncertainty regarding an entity's future losses as well as future gains. Therefore, in simplified terms, there is a natural trade-off between risk and return. Risk is not necessarily related to the size of the potential loss. For example, many potential losses are large but are quite predictable and can be provided for using risk management techniques. The more important concern is the variability of the loss, especially a loss that could rise to unexpectedly high levels or a loss that suddenly occurs that was not anticipated.

As a starting point, **risk management** includes the sequence of activities aimed to reduce or eliminate an entity's potential to incur expected losses. On top of that, there is the need to manage the unexpected variability of some costs. In managing both expected and unexpected losses, risk management can be thought of as a defensive technique. However, risk management is actually broader in the sense that it considers how an entity can consciously determine how much risk it is willing to take to earn future uncertain returns, which involves risk taking.

Risk taking refers specifically to the active assumption of incremental risk in order to generate incremental gains. In that regard, risk taking can be thought of in an opportunistic context.

The Risk Management Process

LO 1.2: Describe the risk management process and identify problems and challenges that can arise in the risk management process.

The risk management process involves the following five steps:

Step 1: Identify the risks.
Step 2: Quantify and estimate the risk exposures *or* determine appropriate methods to transfer the risks.
Step 3: Determine the collective effects of the risk exposures *or* perform a cost-benefit analysis on risk transfer methods.
Step 4: Develop a risk mitigation strategy (i.e., avoid, transfer, mitigate, or assume risk).
Step 5: Assess performance and amend risk mitigation strategy as needed.

In practice, this process is not likely to operate perfectly in the above sequence. Two key problems with the process include identifying the correct risk(s) and finding an efficient method of transferring the risk.

One of the challenges in ensuring that risk management will be beneficial to the economy is that risk must be sufficiently dispersed among willing and able participants in the economy. Unfortunately, a notable failure of risk management occurred during the financial crisis between 2007 and 2009 when it was subsequently discovered that risk was too concentrated among too few participants.

Another challenge of the risk management process is that it has failed to consistently assist in preventing market disruptions or preventing financial accounting fraud (due to corporate governance failures). For example, the existence of derivative financial instruments greatly facilitates the ability to assume high levels of risk and the tendency of risk managers to follow each other's actions (e.g., selling risky assets during a market crisis, which disrupts the market by increasing its volatility).

In addition, the use of derivatives as complex trading strategies assisted in overstating the financial position (i.e., net assets on balance sheet) of many entities and understating the level of risk assumed by many entities. Even with the best risk management policies in place, using such inaccurate information would not allow the policies to be effective.

Finally, risk management may not be effective on an overall economic basis because it only involves risk transferring by one party and risk assumption by another party. It does not result in overall risk elimination. In other words, risk management can be thought of as a zero-sum game in that some "winning" parties will gain at the expense of some "losing" parties. However, if enough parties suffer devastating losses due to an excessive assumption of risk, it could lead to a widespread economic crisis.

MEASURING AND MANAGING RISK

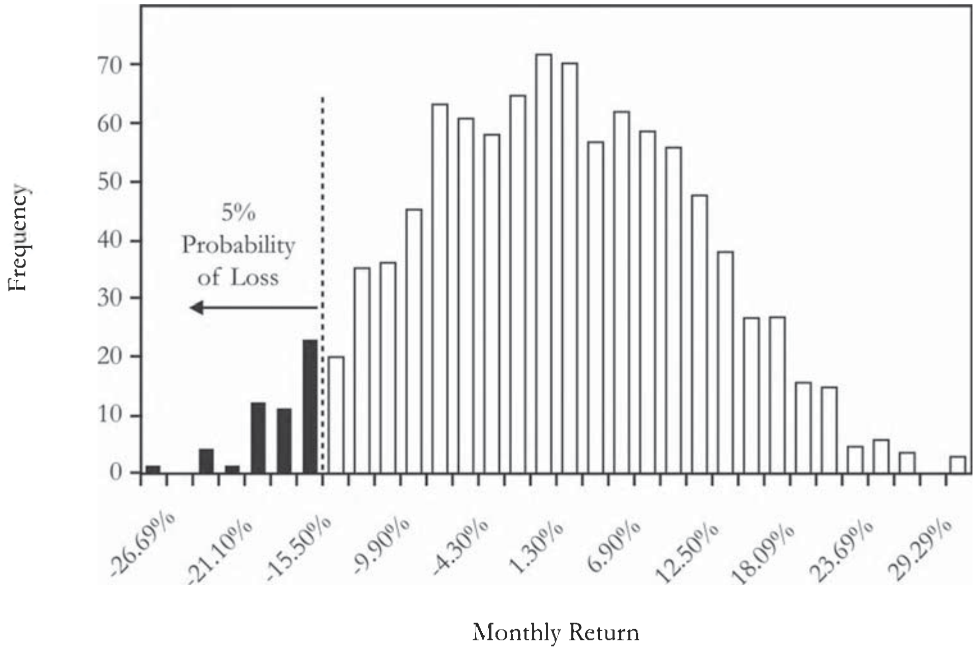
LO 1.3: Evaluate and apply tools and procedures used to measure and manage risk, including quantitative measures, qualitative assessment, and enterprise risk management.

Quantitative Measures

Value at risk (VaR) states a certain loss amount and its probability of occurring. For example, a financial institution may have a one-day VaR of $2.5 million at the 95% confidence level. That would be interpreted as having a 5% chance that there will be a loss greater than $2.5 million on any given day. VaR is a useful measure for liquid positions operating under normal market circumstances over a short period of time. It is less useful and potentially dangerous when attempting to measure risk in non-normal circumstances, in illiquid positions, and over a long period of time.

To further illustrate the concept of VaR, assume you have gathered 1,000 monthly returns for a security and produced the histogram shown in Figure 1. You decide that you want to compute the monthly VaR for this security at a confidence level of 95%. At a 95% confidence level, the lower tail displays the lowest 5% of the underlying distribution's returns. For this distribution, the value associated with a 95% confidence level is a return of –15.5%. If you have $1,000,000 invested in this security, the one-month VaR is $155,000 (–15.5% × $1,000,000).

Figure 1: Histogram of Monthly Returns



Professor's Note: This calculation is an example of historical VaR. In Book 4, we will discuss the main types of value at risk: delta-normal VaR, historical VaR, and Monte Carlo simulation VaR.

Economic capital refers to holding sufficient liquid reserves to cover a potential loss. For example, if one-day VaR is $2.5 million and the entity holds $2.5 million in liquid reserves, then it is unlikely to go bankrupt that day.

Qualitative Assessment

Scenario analysis takes into account potential risk factors with uncertainties that are often non-quantifiable. One option is to consider an adverse scenario or worst-case scenario analysis to get an idea of the full magnitude of potential losses even if they have a very small chance of occurring. Worst-case scenario analysis involves examining the effects of possible macroeconomic scenarios on the entity and within its various divisions, often taking into account several categories of risk.

Stress testing is a form of scenario analysis that examines a financial outcome based on a given "stress" on the entity. For example, it is plausible for interest rates or unemployment rates to rise severely in an economic crisis and stress testing attempts to examine such crisis situations to determine the outcome on the entity.

Enterprise Risk Management (ERM)

ERM takes an integrative approach to risk management within an entire entity, dispensing of the traditional approach of independently managing risk within each department or division of an entity. ERM considers entity-wide risks and tries to integrate risk considerations into key business decisions. Similar to traditional approaches, ERM makes use of measures such as economic capital and stress testing. Senior risk committees may exist within the entity to ensure that risks affecting the entire entity are examined. Within the ERM framework, the entity and its board of directors agree on specific risk exposure limits.

EXPECTED AND UNEXPECTED LOSS

LO 1.4: Distinguish between expected loss and unexpected loss, and provide examples of each.

Expected loss considers how much an entity expects to lose in the normal course of business. It can often be computed in advance (and provided for) with relative ease because of the certainty involved.

For example, a retail business that provides credit terms on sales of goods to its customers (i.e., no need to pay immediately) incurs the risk of non-payment by some of those customers. If the business has been in operation for at least a few years, it could use its operating history to reasonably estimate the percentage of annual credit sales that will never be collected. The amount of the loss is therefore predictable and is treated as a regular cost of doing business (i.e., bad debt expense on the income statement). It can be priced into the cost of the goods directly in the case of the retail business. In contrast, in lines of business in the financial sector, the cost could be recovered by charging commissions on various financial transactions or by implementing spreads between a financial institution's lending rate to borrowers and its cost of obtaining those funds.

Unexpected loss considers how much an entity could lose outside of the normal course of business. Compared to expected loss, it is generally more difficult to predict, compute, and provide for in advance because of the uncertainty involved.

For example, consider a commercial loan portfolio that is focused on loans to automotive manufacturing companies. During an economic expansion that favors such companies (because individuals have more disposable income to spend on items such as automobiles), the lender will realize very few, if any, loan defaults. However, during an economic recession, there is less disposable income to spend and many more loan defaults are likely to occur from borrowers, likely at the same time. This is an example of *correlation risk*, when unfavorable events happen together. The correlation risk drives up the potential losses to unexpected levels.

Another example of correlation risk lies with real estate loans secured by real property. Borrowers tend to default on such loans (i.e., default rate risk) at the same time that the real property values fall (i.e., recovery rate risk—the creditor's collateral is worth less, thereby compromising the recovery rate on the funds lent to the borrowers). These two risks occurring simultaneously could drive up the potential losses to unexpected levels.

Realizing the existence of correlation risks helps a risk manager measure and manage unexpected losses with somewhat more certainty. For example, historical analysis of the extent of such losses in the past due to correlation risk could be performed, taking into account which risk factors were involved.

RISK AND REWARD

LO 1.5: Interpret the relationship between risk and reward and explain how conflicts of interest can impact risk management.

As previously mentioned, there is a trade-off between risk and reward. In very general and simplified terms, the greater the risk taken, the greater the potential reward. However, one must consider the variability of the potential reward. The portion of the variability that is measurable as a probability function could be thought of as risk whereas the portion that is not measurable could be thought of as uncertainty.

The relationship between risk and return appears easier to examine with publicly traded securities. For example, consider fixed-income securities. Government bonds have less credit risk than corporate bonds in general, so the pricing takes into account that the yield spreads for government bonds are narrower than corporate bonds across various maturities. However, for a given maturity, the full relationship between risk and return goes further than merely credit risk (e.g., liquidity risks and taxation impacts may make the relationship less clear). Additionally, the risk tolerances (i.e., ability and willingness to take on certain risks) of market participants may change over time. When risk tolerances are high, the spread between riskless and risky bonds may narrow to an abnormally low level, which again disguises the true relationship between risk and return.

Examining the relationship between risk and return is made even more challenging when dealing with non-publicly traded securities because the pricing of such securities is less reliable compared to publicly traded securities (i.e., no market price validation).

In practice, some entities have weak risk management and/or risk governance cultures, which allows for potential returns to be overstated because they are not adjusted for risk. Correlation risks may be ignored, which understate overall risk. Some risk measures may be computed in a misleading manner because the proper computation may result in lower reported profits for the entity. For example, for entities that have management bonuses based on reported profits, the use of mark to market accounting may result in inflated profits on the income statement (and overstated values for risky assets on the balance sheet) during a strong year in order to maximize the management bonuses paid. However, at the same time, there are usually no adjustments made to risk that considers the fact that those profits have not truly been earned because no cash has been received yet and, in fact, may never materialize if the investments subsequently lose significant value.

RISK CLASSES

LO 1.6: Describe and differentiate between the key classes of risks, explain how each type of risk can arise, and assess the potential impact of each type of risk on an organization.

Market Risk

Market risk considers how changes in market prices and rates will result in investment losses. There are four subtypes of market risk: (1) interest rate risk, (2) equity price risk, (3) foreign exchange risk, and (4) commodity price risk.

Interest rate risk can be illustrated in simple terms by considering a bond earning a fixed rate of interest. If market interest rates rise, the value of the bond will decrease. Another form of interest rate risk is the hedging of bonds against a change in the shape of the yield curve (although it may be properly hedged against a parallel shift in the yield curve). Furthermore, interest rate risk may also arise from having completely unhedged positions or having only partially hedged positions due to underlying transactions that did not fully offset (even though they were meant to offset). In the latter case, the loss could be attributed to *basis risk*, which means that the presumed correlation between the price of a bond and the price of the hedging vehicle used to hedge that bond has changed unfavorably.

Equity price risk refers to the volatility of stock prices. It can be broken up into two parts: (1) *general market risk*, which is the sensitivity of the price of a stock to changes in broad market indices, and (2) *specific risk*, which is the sensitivity of the price of a stock due to unique factors of the entity (e.g., line of business, strategic weaknesses). For the investor, general market risk cannot be diversified away while specific risk can be diversified away.

Foreign exchange risk refers to monetary losses that arise because of unhedged or not fully hedged foreign currency positions. Foreign exchange risk results from imperfect correlations in currency price movements as well as changes in international interest rates. Potential large losses could reduce the extent of an entity's foreign investment and also put it at a competitive disadvantage compared to its foreign competitors.

Commodity price risk refers to the price volatility of commodities (e.g., precious metals, base metals, agricultural products, energy) due to the concentration of specific commodities in the hands of relatively few market participants. The resulting lack of trading liquidity tends to increase the amount of price volatility compared to financial securities. In addition, commodities may face significant price discontinuities (i.e., prices suddenly jump from one level to another).

Credit Risk

Credit risk refers to a loss suffered by a party whereby the counterparty fails to meet its financial obligations to the party under the contract. Credit risk may also arise if there is an increasing risk of default by the counterparty throughout the duration of the contract. There are four subtypes of credit risk: (1) default risk, (2) bankruptcy risk, (3) downgrade risk, and (4) settlement risk.

Default risk refers to the non-payment of interest and/or principal on a loan by the borrower to the lender. The period of default past the due date could be at least 30 or 60 days.

Bankruptcy risk involves taking possession of any collateral provided by the defaulting counterparty. The risk is that the liquidation value of the collateral is insufficient to recover the full loss on default.

Downgrade risk considers the decreased creditworthiness (based on recent financial performance) of a counterparty to a transaction. A creditor may subsequently charge the downgraded entity a higher lending rate to compensate for the increased risk. For a creditor, downgrade risk may eventually lead to default risk.

Settlement risk could be illustrated using a derivatives transaction between two counterparties. At the settlement date, one of them is in a net gain ("winning") position and the other is in a net loss ("losing") position. The position that is losing may simply refuse to pay and fulfill its obligations.

Continuing with the concept of a net gain position in a transaction, credit risk exists only to that party. If the losing party defaults, then the winning party may lose some or all of that net gain. The portion that is expected to be recovered is called the *recovery value* and the portion that is expected to be lost is the *loss given default* (LGD). For example, if a party's net gain position is $500,000 at settlement and only $400,000 is expected to be recovered, then the recovery value is $400,000 and the LGD is $100,000. Expressed as percentages, the recovery rate is 80% and the LGD is 20%.

It is also necessary to consider credit risk within a portfolio of loans. The basic issue is to ensure that the lender charges a rate of interest to the borrower that is commensurate with the risk taken. In addition, in order to avoid concentration risk, the lender should ensure sufficient diversification of loans across geographical areas and industries. Somewhat related to concentration risk are correlation risk and overall economic health. Economic recessions will result in more loan defaults and there is tendency for loans in similar geographical areas or industries to default at the same time. Finally, loan portfolios should consider the maturities of the loans and avoid concentration on specific maturities, giving rise to portfolio maturity risk. A more diversified portfolio with loans across a reasonable range of maturities will also help avoid liquidity risk by having more frequent cash inflows (i.e., loan principal repayments) over time rather than having most of the cash inflows at only specified times.

Liquidity Risk

Liquidity risk is subdivided into two parts: (1) funding liquidity risk and (2) trading liquidity risk.

Funding liquidity risk occurs when an entity is unable to pay down or refinance its debt, satisfy any cash obligations to counterparties, or fund any capital withdrawals. **Trading liquidity risk** occurs when an entity is unable to buy or sell a security at the market price due to a temporary inability to find a counterparty to transact on the other side of the trade. For a transaction that must be executed immediately or in the near future, it might have to be done at a very significant discount, thereby leading to a huge loss. The loss effect is magnified for larger transactions.

The impact of trading liquidity risk on an entity could include impairments in its abilities to control market risk and to cover any funding shortfalls.

Operational Risk

Operational risk considers a wide range of “non-financial” problems such as inadequate computer systems (technology risk), insufficient internal controls, incompetent management, fraud (e.g., losses due to intentional falsification of information), human error (e.g., losses due to incorrect data entry or accidental deletion of a file), and natural disasters.

Within a financial institution, the leveraged nature of derivatives transactions makes them susceptible to operational risk. Additionally, the difficulty in accurately valuing complicated derivatives transactions adds to operational risk.

A very robust system of internal controls is required within an entity or else there is a risk of significant losses due to various operational risks.

Legal and Regulatory Risk

In practice, legal and regulatory risk is highly integrated with operational and reputation risk. Within a two-way financial transaction, an example of legal risk would be one party suing the other party in an attempt to nullify or terminate the transaction. From an investing perspective, an example of regulatory risk could be a change in tax law that increases the tax rate of certain types of income, thereby lowering the after-tax investment returns for many investors, or changes in regulations that involve further areas of compliance, thereby increasing compliance costs for an entity.

Business Risk

For the purposes of this topic, we will consider business risk from a financial perspective. In this regard, business risk revolves around uncertainty regarding the entity's income statement, although, in practice, there is a substantial amount of integration with strategic and reputation risk. From an income statement perspective, revenues may be uncertain because of the uncertainty surrounding the demand for products and/or the price that should be set. Production and administration costs may also be uncertain.

Business risk may arise because the actual product demand is significantly lower than anticipated or the marketplace's toleration of a selling price is much lower than expected. In addition, there may be production cost overruns or unexpected costs that substantially increase total expenses. Either way, the decreased revenues and/or the increased costs may be significant enough that the entity suffers financial losses.

From a non-financial (i.e., operational) perspective, a manufacturing company may experience business risk due to testing, production, or shipping delays. The result would be lost sales and/or substitution to competitors' products by consumers.

Strategic Risk

Strategic risk can be thought of in the context of large new business investments, which carry a high degree of uncertainty as to ultimate success and profitability. For example, an entity could spend millions of dollars developing a new product that ultimately fails in the marketplace because consumers find it unsuitable for their needs.

Alternatively, it could be thought of from the perspective of an entity changing its business strategy compared to its competitors. For example, a financial institution may choose to change its lending focus from lending to stable firms and attempt to lend funds to risky firms at high rates of interest in order to earn higher profits. However, an economic crisis ensues and many of those risky firms default on their loans, leading to large losses to the lending financial institution.

The impact of strategic risk will be felt by an entity if its business decision has an unsuccessful result, thereby incurring large losses and loss of reputation/confidence by investors.

Reputation Risk

Reputation risk consists of two parts: (1) the general perceived trustworthiness of an entity (i.e., that the entity is able and willing to meet its obligations to its creditors and counterparties) and (2) the general perception that the entity engages in fair dealing and conducts business in an ethical manner.

Reputation risk could arise partly due to the existence of the internet. For example, social networking sites and blogs could allow for rumors—true or false—to be spread about an entity very quickly. An entity's involvement in questionable and sophisticated financial transactions such as structured finance products or special purpose entities may give rise to reputation risk for an entity because the interpretation of the accounting and tax rules related to such transactions may be misleading and border on illegal in some cases.

The impact of reputation risk on an entity could start with lost profits and eventually lead to insolvency as public perception of the entity diminishes together with the value of the entity.

KEY CONCEPTS

LO 1.1

Risk arises from the uncertainty regarding an entity's future losses as well as future gains. Risk management includes the sequence of activities aimed to reduce or eliminate an entity's potential to incur expected losses. Risk taking refers specifically to the active assumption of incremental risk in order to generate incremental gains.

LO 1.2

In its basic format, the risk management process is as follows:

Step 1: Identify the risks.
Step 2: Quantify and estimate the risk exposures or determine appropriate methods to transfer the risks.
Step 3: Determine the collective effects of the risk exposures or perform a cost-benefit analysis on risk transfer methods.
Step 4: Develop a risk mitigation strategy (i.e., avoid, transfer, mitigate, or assume risk).
Step 5: Assess performance and amend risk mitigation strategy as needed.

LO 1.3

Value at risk (VaR) states a certain loss amount and its probability of occurring.

Economic capital refers to holding sufficient liquid reserves to cover a potential loss.

Scenario analysis takes into account potential risk factors with uncertainties that are often non-quantifiable.

Stress testing is a form of scenario analysis that examines a financial outcome based on a given "stress" on the entity.

Enterprise risk management takes an integrative approach to risk management within an entire entity, dispensing of the traditional approach of independently managing risk within each department or division of an entity.

LO 1.4

Expected loss considers how much an entity expects to lose in the normal course of business. It can often be computed in advance (and provided for) with relative ease because of the certainty involved.

Unexpected loss considers how much an entity could lose usually outside of the normal course of business. Compared to expected loss, it is generally more difficult to predict, compute, and provide for in advance because of the uncertainty involved.

LO 1.5

There is a trade-off between risk and reward. In very general and simplified terms, the greater the risk taken, the greater the potential reward. However, one must consider the variability of the potential reward. The portion of the variability that is measurable as a probability function could be thought of as risk whereas the portion that is not measurable could be thought of as uncertainty.

LO 1.6

There are eight key classes of risk: (1) market risk, (2) credit risk, (3) liquidity risk, (4) operational risk, (5) legal and regulatory risk, (6) business risk, (7) strategic risk, and (8) reputation risk.

Market risk considers how changes in market prices and rates will result in investment losses. There are four subtypes of market risk: (1) interest rate risk, (2) equity price risk, (3) foreign exchange risk, and (4) commodity price risk.

Credit risk refers to a loss suffered by a party whereby the counterparty fails to meet its financial obligations to the party under the contract. Credit risk may also arise if there is an increasing risk of default by the counterparty throughout the duration of the contract. There are four subtypes of credit risk: (1) default risk, (2) bankruptcy risk, (3) downgrade risk, and (4) settlement risk.

Liquidity risk is subdivided into two parts: (1) funding liquidity risk and (2) trading liquidity risk. Funding liquidity risk occurs when an entity is unable to pay down or refinance its debt, satisfy any cash obligations to counterparties, or fund any capital withdrawals. Trading liquidity risk occurs when an entity is unable to buy or sell a security at the market price due to a temporary inability to find a counterparty to transact on the other side of the trade.

Operational risk considers a wide range of non-financial problems such as inadequate computer systems, insufficient internal controls, incompetent management, fraud, human error, and natural disasters.

Legal risk could arise when one party sues the other party in an attempt to nullify or terminate the transaction. Regulatory risk could arise from changes in laws and regulations that are unfavorable to the entity (e.g., higher tax rates, higher compliance costs).

Business risk revolves around uncertainty regarding the entity's income statement. Revenues may be uncertain because of the uncertainty surrounding the demand for the products and/or the price that should be set. Production and administration costs may also be uncertain.

Strategic risk can be thought of in the context of large new business investments, which carry a high degree of uncertainty as to ultimate success and profitability. Alternatively, it could be thought of from the perspective of an entity changing its business strategy compared to its competitors.

Reputation risk consists of two parts: (1) the general perceived trustworthiness of an entity (i.e., that the entity is able and willing to meet its obligations to its creditors and counterparties) and (2) the general perception that the entity engages in fair dealing and conducts business in an ethical manner.

CONCEPT CHECKERS

1. Which of the following statements regarding risk and risk management is correct?
   A. Risk management is more concerned with unexpected losses versus expected losses.
   B. There is a relationship between the amount of risk taken and the size of the potential loss.
   C. The final step of the risk management process involves developing a risk mitigation strategy.
   D. If executed properly, the risk management process may allow for risk elimination within an economy.

2. Examining the impact of a dramatic increase in interest rates on the value of a bond investment portfolio could be performed using which of the following tools?
   I. Stress testing.
   II. Enterprise risk management.
   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

3. Which of the following items would be associated with unexpected losses?
   I. Loan defaults are increasing simultaneously while recovery rates are decreasing.
   II. Lending losses are covered by charging a spread between the cost of funds and the lending rate.
   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

4. In considering the major classes of risks, which risk would best describe an entity with weak internal controls that could easily be circumvented with a lack of segregation of duties?
   A. Business risk.
   B. Legal and regulatory risk.
   C. Operational risk.
   D. Strategic risk.

5. Local Bank, Inc., (LBI) has loaned funds to a private manufacturing company, named We Make It All (Make It). The current balance of the loan is $1 million and it is secured by a piece of land and the corresponding building owned by Make It. Due to an economic downturn, Make It suffered a loss for the first time in its 10-year operating history and is currently experiencing some cash flow difficulties. In addition, the land and building that is held as collateral has recently been appraised at only $800,000. Based only on the information provided, which of the following risks faced by LBI have increased?
   A. Bankruptcy risk and default risk.
   B. Bankruptcy risk and settlement risk.
   C. Default risk and downgrade risk.
   D. Default risk, downgrade risk, and settlement risk.

CONCEPT CHECKER ANSWERS

1. **A** Risk management is more concerned with the variability of losses, especially ones that could rise to unexpectedly high levels or ones that suddenly occur that were not anticipated (unexpected losses).

   Choice B is not correct because risk is not necessarily related to the size of the potential loss. For example, many potential losses are large but are quite predictable and can be provided for using risk management techniques. Choice C is not correct because the final step of the risk management process involves assessing performance and amending the risk mitigation strategy as needed. Choice D is not correct because the risk management process only involves risk transferring by one party and risk assumption by another counterparty. It is a zero-sum game so it does not result in overall risk elimination.

2. **C** Examining the impact of a dramatic increase in interest rates is an example of stress testing. Enterprise risk management makes use of measures such as stress testing.

3. **A** Loan defaults are increasing simultaneously while recovery rates are decreasing is an example of correlation risk. Correlation risk could drive up the potential losses to unexpected levels.

   In contrast, if lending losses are covered with a spread, given that there is sufficient information to compute such a spread, then the losses would likely be considered expected losses.

4. **C** Weak internal controls and lack of segregation of duties would represent a non-financial risk and be best described as an operational risk.

   Choice A is not correct because business risk focuses on the income statement (i.e., revenues too low and expenses too high). Choice B is not correct because legal and regulatory risk focuses on the risk of an entity being sued or the risk of unfavorable changes in the rules and laws that the entity must follow. Choice D is not correct because strategic risk focuses on significant new business investments or significant changes in an entity's business strategy.

5. **A** The fact that the loan is secured by land and the building is now worth less than the amount of the loan outstanding subjects LBI to increased *bankruptcy risk* in the sense that the liquidation value of the collateral is insufficient to recover the loss if the loan defaults. The financial loss and the cash flow difficulties suggest that there is increased *default risk* for LBI as well.

   Downgrade risk does not apply here because Make It's loan is not publicly traded and is unlikely to be rated by a recognized rating agency. *Settlement risk* does not apply here either because there is no exchange of cash flows at the end of the transaction that would be required to incur such risk. In this case, the loan is settled when Make It fully repays the principal balance owed.

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The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

CORPORATE RISK MANAGEMENT: A PRIMER

Topic 2

EXAM FOCUS

This topic builds on the material from the previous topic and provides coverage of additional fundamental concepts such as the capital asset pricing model (CAPM), the advantages of hedging, financial versus operating risk, and commonly encountered types of risk such as pricing risk, foreign exchange risk, and interest rate risk. For the exam, pay close attention to the material on hedging risk exposures, the role of the board of directors in determining whether to hedge specific risk factors, and foreign currency risk.

HEDGING RISK EXPOSURES

LO 2.1: Evaluate some advantages and disadvantages of hedging risk exposures.

Disadvantages (In Theory)

In 1958, Franco Modigliani and Merton Miller argued that under the assumption of perfectly competitive capital markets with no transaction costs or taxes, both the firm and the individual investor are able to perform the same financial transactions at the same cost. In other words, the value of the firm will remain constant despite any attempt to hedge risk exposures. Unfortunately, the assumption of no transaction costs or taxes is highly unrealistic in the real world, which makes it a weak argument not to hedge risk.

In 1964, William Sharpe developed the capital asset pricing model (CAPM), which argues that under perfect capital markets, firms should only be concerned with **systematic risk** (or *beta* risk; risk that is common to all market participants). Firms should not be concerned with **unsystematic risk** (or *idiosyncratic* risk) that pertains specifically to the firm because such risk could be reduced through diversification in a large investment portfolio and in a costless manner. Unfortunately, the perfect capital markets assumption is not realistic in practice, and diversification activities will result in transaction costs.

There is the belief by many market participants that hedging is a zero-sum game that has no long-term increase on a firm's earnings or cash flows (because earnings/cash flows are simply moved between periods). That argument assumes perfect capital markets and that derivatives pricing fully reflects all of its risk factors. Unfortunately, in practice, derivatives pricing is extremely complex and not as accurate compared to equity and bond pricing. Therefore, derivatives pricing is not always likely to reflect all of its risk factors so hedging with derivatives may not always be a zero-sum game of transferring risk between periods or between participants.

A noteworthy point is that none of the above arguments consider the existence of the significant costs of financial distress and bankruptcy, a point that runs contrary to the assumption of perfect capital markets.

Disadvantages (In Practice)

Hedging activities may be extensive enough that they cause management to lose focus on the core business activities of the firm, possibly resulting in lost profits. Hedging often requires very specific skills, knowledge, research, and time, which may not be available within the management team. In addition, attempting to hedge using a flawed hedging strategy may result in losses to the firm that are greater than the actual risk(s).

All hedging strategies will incur compliance costs, such as ones related to disclosure and accounting. Also, the use of derivatives (e.g., futures contracts) to hedge may reveal operational information that a firm may otherwise prefer to keep private. Such costs would reduce the firm's incentive to hedge its risks. Finally, hedging to decrease the variability of the firm's value may end up increasing the variability of the firm's earnings due to the difference between accounting earnings and cash flows.

Advantages (In Practice)

One of the key reasons for a firm to hedge its risk exposures is the possibility of lowering its cost of capital (debt or equity), which could lead to increased economic growth. By reducing the volatility of its earnings/cash flows, a firm may be able to increase its debt capacity in order to borrow funds to take advantage of lucrative investment opportunities. Also, borrowing arrangements for firms with less volatile earnings/cash flows usually contain fewer conditions and restrictions imposed by the lenders.

Similarly, reduced volatility and greater stability of earnings/cash flows is often an indication to the firm's stakeholders that management is doing a good job. This is often reflected directly in the firm's stock price being stable or rising.

Hedging may allow management to control its financial performance to meet the requirements of the board of directors. For example, management is implicitly conveying the level of risk it is able and willing to accept on an unhedged basis (i.e., its risk appetite) when it makes choices on hedging specific risk exposures. The risk appetite would need to be approved in advance by the board so hedging may assist management in meeting the board's requirements.

Hedging may result in operational improvements within a firm. For example, for a manufacturing firm, cost and price stability may be achieved if it is able to ascertain a locked-in price for its inputs.

Hedging through the use of derivatives instruments such as swaps and options may be cheaper than purchasing an insurance policy. One must consider whether the total cost of the insurance over the years exceeds the estimated losses.

Some arguments for hedging are focused on taxation. The existence of progressive tax rates may result in volatile earnings (with no hedging) incurring more income tax liability compared to stable earnings (with hedging). In addition, hedging with derivatives (off-balance sheet) may allow for more debt financing, which results in more tax deductions for interest costs incurred. In practice, neither argument seems to have much validity. For example, the tax liabilities tend to even out between the volatile and non-volatile years, especially because losses in one year may be offset against income in another year.

HEDGING DECISIONS

LO 2.2: Explain considerations and procedures in determining a firm's risk appetite and its business objectives.

LO 2.3: Explain how a company can determine whether to hedge specific risk factors, including the role of the board of directors and the process of mapping risks.

As a start, a firm must know its risk and return goals before embarking on a risk management plan. Those goals must be evaluated and approved by the board of directors to ensure the plan is focused and relevant. A major conclusion to consider with the risk/return trade-off is that firms should accept all projects with a positive net present value (NPV), taking into account risk, because it will maximize value for the firm's stakeholders.

The Role of the Board of Directors

Management and the board need to set and communicate the firm's **risk appetite** in a quantitative and/or qualitative manner. There are several possibilities, including:

- Explicitly stating (qualitatively) which risks the firm can tolerate (to be left unhedged) and, therefore, which risks it cannot tolerate (to be hedged).
- Using a quantitative metric such as value at risk (VaR) to convey the maximum loss the firm will tolerate for a given confidence level for a given period of time.
- Using stress testing whereby management considers possible but very severely negative scenarios to determine the level of losses. From there, the board makes the determination of which losses are tolerable (to not mitigate or to leave uninsured) and which ones are not tolerable (to be mitigated or insured).

A problematic issue for the board of directors in determining the firm's risk appetite centers on the potential conflict between the two major stakeholders—debtholders and shareholders. Debtholders would likely be more concerned with minimizing all risks because their upside potential is generally limited to the rate of interest charged. In contrast, shareholders may be willing for the firm to accept a large but unlikely risk in order to increase equity returns.

The board must ensure that its goals are stated in a clear and actionable manner. From a performance evaluation/measurement perspective, criteria to determine the relative success in meeting those goals must be set in advance to ensure objectivity in the process.

The board should clarify its objectives in terms of whether it is accounting or economic profits that are to be hedged. For example, a domestic firm may have an overseas subsidiary with assets that are financed by loans (for the exact same dollar value) in the same currency.

This represents a hedging of economic profits. However, if that subsidiary is not considered self-sustaining and is integrated with the domestic firm, then the loan is maintained in the foreign currency but the assets must be translated to the domestic currency, thereby creating foreign exchange risk for the accounting profits. So if the foreign currency appreciates relative to the domestic currency, upon translation to the domestic currency, there will be a translation loss for accounting purposes. Of course, the accounting profits could be hedged by purchasing a forward contract on the foreign currency; however, that will create economic risk. The bottom line is that it is not possible to hedge both accounting and economic risk at the same time, so a choice between the two must be made.

Additionally, the issue of hedging short-term versus long-term accounting profits (i.e., smoothing the fluctuations over the years) needs to be considered. Doing so may entail significant effort and cost from a cash flow perspective. However, one argument in favor of smoothing is that for publicly traded companies, stable reported earnings (rather than fluctuating) often assist with maintaining or increasing the stock price.

The board must be definitive in the time horizon when determining its risk management goals for management to achieve. Liquidity, accounting, and tax effects need to be considered. For example, the use of a futures contract to hedge future sales receipts will result in a mismatch of profits for accounting purposes (e.g., sales revenue recognized only upon completion of transaction while the futures contract requires periodic marking to market), or if the futures contract is in a “gain” position at the end of the year, there may be taxes payable prior to the receipt of any sales receipts (liquidity and tax effects).

Finally, the board may wish to implement definitive and quantitative risk limits within which management is allowed to transact at its own discretion. Any amounts outside of those limits would not be permissible, would require special approval from the board, or would require hedging.

The Process of Mapping Risks

Mapping risks is the next logical step once management and the board have determined which risks to accept and which ones to manage. In that regard, it must be clear which risks are insurable, hedgeable, noninsurable, or nonhedgeable in order to determine what items could be used to reduce the firm’s risk.

Mapping risks could be performed for market risk, credit risk, business risk, and operational risk. Using currency risk as an example of market risk, consider the impact of currency risk on a firm’s current positions and future transactions. Management could start with the balance sheet by determining the values of all assets and liabilities that could be impacted by exchange-rate fluctuations and break them out into the different currencies. Then it could move on to the income statement and request internal information on confirmed (and possibly unconfirmed) future sales to foreign customers in the various currencies for the relevant period. The same would be done for expenses to be incurred. Once all the information is gathered, the timing of cash inflows and outflows for each currency can be analyzed to determine the next steps (i.e., how much to hedge, which currencies to hedge).

On an overall basis, the firm should also research and identify the top 10 risk exposures it faces. For each of those risks, a dollar value should be assigned to indicate the potential loss as well as a probability to indicate the likelihood of it happening. Similarly, management should be aware of its general exposure to fluctuations in interest rates, foreign exchange rates, equity prices, and commodity prices.

HEDGING OPERATIONAL AND FINANCIAL RISKS

LO 2.4: Apply appropriate methods to hedge operational and financial risks, including pricing, foreign currency, and interest rate risk.

Hedging operational risks covers a firm's activities in production (costs) and sales (revenue), which is essentially the income statement. Financial position risk pertains to a firm's balance sheet. Making the realistic assumption that there are some imperfections in the financial markets, a firm could benefit from hedging financial position risk. Hedging activities should cover both the firm's assets and liabilities in order to fully account for the risks.

Pricing Risk

With production, the cost of inputs may have a significant impact on the firm's ability to conduct its business in a competitive manner. Therefore, it makes sense to hedge such pricing risk by purchasing a forward or futures contract to buy a specific quantity of that input at a fixed cost determined in advance. The same could be done with a firm's domestic or foreign sales, as will be discussed next.

Foreign Currency Risk

The goal of hedging foreign currency risk is to control exposure to exchange rate fluctuations that impact future cash flows and the fair value of assets and liabilities.

Revenue hedging can be used when a firm has sales to customers in foreign countries (with payment in the foreign currency). There is the risk of the devaluation of the foreign currency in the future, resulting in losses to the firm when the funds are ultimately converted back to the domestic currency. The firm could hedge some of its expected foreign currency receipts in the future, taking into account the cost of hedging as well as revenue and exchange-rate volatilities and correlations. Instruments that could be used include currency put options (to ensure a known absolute minimum return should the exchange rate fall beyond the strike rate) and forward contracts (to ensure a known return based on an exchange rate determined in advance and acceptable by the firm).

In hedging the firm's balance sheet exposures, the focus is on the impact of foreign exchange rate fluctuations on the net monetary assets of its foreign investments. Forward contracts are often used in this regard because they allow for the payment ("loss") or receipt ("gain") by the firm of a fixed amount at a fixed exchange rate that would offset any impact of rate changes on the net monetary assets (gain or loss; opposite of the forward contract). Foreign currency debt (liability) could also serve as a natural offset against a decrease in the value of a firm's foreign investment (asset). Note that in some instances hedging costs are prohibitively expensive from a cost-benefit perspective and therefore some foreign currency positions may be left deliberately unhedged.

Interest Rate Risk

The goal of hedging interest rate risk is to control the firm's net exposure (asset or liability) to unfavorable interest rate fluctuations. From both an investing and a borrowing perspective, interest rate swaps may be used to protect a firm against losses. Also, it may help a firm to minimize its borrowing costs. Identical to the point above about high hedging costs, some interest rate positions may be left deliberately unhedged.

Static vs. Dynamic Hedging Strategies

A *static hedging strategy* is a simple process in which the risky investment position is initially determined and an appropriate hedging vehicle is used to match that position as close as possible and for as long as required. In contrast, a *dynamic hedging strategy* is a more complex process that recognizes that the attributes of the underlying risky position may change with time. Assuming it is desired to maintain the initial risky position, there will be additional transaction costs required to do so. Significantly more time and monitoring efforts are required with a dynamic hedging strategy.

Additional hedging considerations include the following:

- The firm must consider relevant time horizons for hedging and ensure that performance evaluations are matched with the time horizons.
- The firm needs to assess the (often) complex financial accounting implications of hedging with derivatives. For example, if the hedge is not an exact match or offset to the underlying position, then there will be a gain/loss to report on the income statement.
- The taxation of derivatives is a key issue because of its impact on the firm's cash flows as well as the differing laws between countries. Significant effort and cost (which increase hedging costs) may be required to decipher the complex tax rules surrounding derivatives.

RISK MANAGEMENT INSTRUMENTS

LO 2.5: Assess the impact of risk management instruments.

Once the risks are mapped, management and the board need to determine which instruments to use to manage the risks. As stated previously, a simple example would be a foreign subsidiary with assets that are hedged with an equal dollar amount of liabilities. The same can be done for a foreign liability with a foreign asset. The underlying assumption is that the time horizon is appropriate.

For other transactions, decisions need to be made whether to fully insure, partially insure, or not to insure (i.e., self-insure) with insurance products, taking into account the benefits and costs of doing so.

Financial instruments are used to hedge risks and can be classified as exchange traded or over the counter (OTC). **Exchange-traded instruments** cover only certain underlying assets and are quite standardized (e.g., maturities and strike prices) in order to promote liquidity in the marketplace. **OTC instruments** are privately traded between a bank and a firm and thus can be customized to suit the firm's risk management needs. In exchange for the customization, OTC instruments are less liquid and more difficult to price than exchange-traded instruments. In addition, there is credit risk by either of the counterparties (e.g., default risk) that would generally not exist with exchange-traded instruments.

KEY CONCEPTS

LO 2.1

There are some theoretical reasons for a firm not to hedge risk exposures but most of those reasons make the unrealistic assumption of perfect capital markets, which is not realistic. Also, they ignore the existence of the significant costs of financial distress and bankruptcy. However, in practice, there are some valid reasons not to hedge, including the distraction from focusing on the core business, lack of skills and knowledge, and transaction and compliance costs.

Many reasons exist for a firm to hedge its risk exposures. Key reasons include lowering the cost of capital, reducing volatility of reported earnings, operational improvements, and potential cost savings over traditional insurance products.

LO 2.2

The board, together with management, should set the firm's risk appetite using one or more of the following tools: qualitative statements of risk tolerance, value at risk, and stress testing. A firm must know its risk and return goals before embarking on a risk management plan. These goals must be clear and actionable.

LO 2.3

In hedging specific risk factors, it is necessary to consider the role of the board of directors as well as the process of mapping. There should be clarification whether accounting or economic profits are to be hedged. Likewise, there should be clarification whether short-term or long-term accounting profits are to be hedged. Other points the board should consider include the time horizon and the possibility of implementing definitive and quantitative risk limits.

Mapping risks requires clarification as to which risks are insurable, hedgeable, noninsurable, or nonhedgeable. Mapping risks could be performed for various risks such as market, credit, business, and operational. Essentially, it involves a detailed analysis of the impacts of such risks on the firm's financial position (balance sheet) and financial performance (income statement).

LO 2.4

Hedging operational risks tend to cover a firm's income statement activities while hedging financial risks tend to cover the balance sheet. Pricing risk could be thought of as a type of operational risk, requiring the hedging of revenues and costs. Foreign currency risk refers to the risk of economic loss due to unfavorable changes in the foreign currency exchange rate; to the extent that there is production and sales activity in the foreign currency, pricing risk would exist simultaneously. Interest rate risk refers to the risk inherent in a firm's net exposure to unfavorable interest rate fluctuations.

Hedging strategies could be categorized as either static or dynamic, with dynamic strategies being more complex and requiring additional monitoring and transaction costs. Additionally, factors such as time horizon, accounting, and taxation need to be considered within any hedging strategy.

LO 2.5

Once the risks are mapped, management and the board need to determine which instruments to use to manage the risks. The relevant instruments can be classified as exchange traded or over the counter (OTC). Exchange-traded instruments are generally quite standardized and liquid. OTC instruments are more customized to the firm's needs and therefore less liquid. An element of credit risk is also introduced with OTC instruments.

CONCEPT CHECKERS

1. Melody Li is a junior risk analyst who has recently prepared a report on the advantages and disadvantages of hedging risk exposures. An excerpt from her report contains four statements. Which of Li's statements is correct?
   A. Purchasing an insurance policy is an example of hedging.
   B. In practice, hedging with derivatives is not likely to be a zero-sum game.
   C. The existence of significant costs of financial distress and bankruptcy is considered within the assumption of perfect capital markets.
   D. Hedging with derivatives is advantageous in the sense that there is often the ability to avoid numerous disclosure requirements compared with other financial instruments.

2. The involvement of the board of directors is important within the context of a firm's decision to hedge specific risk factors. Which of the following statements regarding the setting of risk appetite is correct?
   I. Risk appetite may be conveyed strictly in a qualitative manner.
   II. Debtholders and shareholders are both likely to desire minimizing the firm's risk appetite.
   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

3. Which of the following statements regarding the hedging of risk exposures is correct?
   A. The use of a futures contract to hedge future sales receipts may result in premature taxes payable.
   B. Hedging both accounting and economic risk may be done simultaneously but at a relatively high cost.
   C. For publicly traded companies, there is no clear benefit in hedging short-term or long-term accounting profits.
   D. The use of a futures contract to hedge future sales receipts may assist in matching profits for accounting purposes.

4. Lear, Inc., is a U.S. wine producer that purchases a significant amount of cork for its wine bottles from Asia. It also sells much of its wine to customers throughout North America. Based on these two broad transactions, which of the following risks does Lear, Inc., most likely face?
   A. Financial position risk and operational risk.
   B. Operational risk and pricing risk.
   C. Pricing risk only.
   D. Financial position risk, operational risk, and pricing risk.

5. Which of the following statements regarding exchange-traded and over-the-counter (OTC) financial instruments is correct?
   A. There is greater liquidity with exchange-traded financial instruments.
   B. There is greater customization with exchange-traded financial instruments.
   C. There is greater price transparency with OTC financial instruments.
   D. There is credit risk by either of the counterparties inherent in exchange-traded instruments.

CONCEPT CHECKER ANSWERS

1. B The complexity of derivatives pricing means the pricing may not always be as accurate as possible so it will not always reflect all of the relevant risk factors. As a result, in practice, hedging with derivatives may not be a zero-sum game of transferring risk between periods or between participants.

   Choice A is not correct because hedging involves the use of financial derivatives and insuring involves the use of insurance policies; an insurance policy is not considered a financial instrument in the same sense as a derivatives instrument. Choice C is not correct because the existence of significant costs of financial distress and bankruptcy is contrary to the assumption of perfect capital markets. Choice D is not correct because hedging with derivatives will require disclosure, including some operational information that the firm may otherwise prefer to keep private.

2. A Risk appetite may be conveyed in a qualitative and/or quantitative manner, therefore, qualitative alone may be acceptable.

   Debtholders would likely be more concerned about minimizing all risks because their upside potential is generally limited to the rate of interest charged. In contrast, shareholders may be willing for the firm to accept a large but unlikely risk in order to increase equity prices.

3. A The use of a futures contract to hedge future sales receipts must take into account that sales revenue is recognized only upon completion of transaction, although the futures contract requires periodic marking to market. Therefore, if the futures contract is in a "gain" position at the end of the year, there may be taxes payable prior to the receipt of any sales receipts.

   Choice B is not correct because it is not possible to hedge both accounting and economic risk at the same time. Choice C is not correct because for publicly traded companies, stable reported earnings (achieved by hedging short-term vs. long-term accounting profits) often assist with maintaining or increasing the stock price. Choice D is not correct because the use of a futures contract to hedge future sales receipts will result in a mismatch of profits for accounting purposes.

4. B *Operational risk* could cover activities pertaining to Lear's input products (i.e., cork) and products exported to foreign countries (i.e., bottles of wine). In addition, there would be *pricing risk* for both the inputs and outputs. For example, the cost of the cork may have a significant impact on Lear's ability to conduct business in a competitive manner. Also consider that Lear has sales to customers in foreign countries (with payment in the foreign currency) where there is the risk of the devaluation of the foreign currency in the future. *Financial position risk* refers to the balance sheet of a firm. Neither the purchases nor the sales impact Lear's balance sheet.

5. **A** Exchange-traded instruments cover only certain underlying assets and are quite standardized in order to promote liquidity in the marketplace. As a result, there is less customization with exchange-traded instruments. OTC financial instruments, in exchange for greater customization, are less liquid and more difficult to price compared to exchange-traded instruments. In addition, there is credit risk by either of the counterparties that would generally not exist with exchange-traded instruments.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

CORPORATE GOVERNANCE AND RISK MANAGEMENT

Topic 3

EXAM FOCUS

This topic continues the coverage of risk management concepts in a qualitative and non-technical manner. For the exam, pay close attention to the best practices in corporate governance and risk management. In addition, understand the purpose and function of the main board committees, such as risk management, compensation, and audit.

BEST PRACTICES

LO 3.1: Compare and contrast best practices in corporate governance with those of risk management.

Corporate Governance

The board of directors should be comprised of a majority of independent members in order to maintain a sufficient level of objectivity with regard to making decisions and approving management's decisions. All members should possess a basic knowledge of the firm's business and industry, even if they are outside of the industry. Additionally, those who lack knowledge should be provided some supplemental training prior to joining the board.

The board should be watching out for the interests of the shareholders. For example, on a general level, the board would have to approve management's decision to assume a certain risk given its expected return. Also, the board would watch out for the interests of other stakeholders, such as debtholders, by considering if any of management's decisions contain extreme downside risk.

The board should be aware of any agency risks whereby management may have the incentive to take on greater risks in order to maximize personal remuneration (e.g., based on short-term increases in stock price) that are not consistent with the objectives of the stakeholders in terms of long-term risk levels. As a starting point, the compensation committee within the board should design management compensation plans so they are congruent with corporate goals in addition to minimizing or reducing agency risk.

The board should maintain its independence from management. A key measure involved would be that the chief executive officer (CEO) would not also be the chairman of the board because there is already an inherent conflict with the CEO being on both the management team and the board of directors. As a result, the CEO should not be given additional powers on the board.

The board should consider the introduction of a chief risk officer (CRO). The CRO would technically be a member of management but would attend board meetings. The CRO's objective would be to link the corporate governance duties to the firm's risk management objectives. In terms of reporting, the CRO could report to the board and/or the management team, depending on the specific nature of the CRO role within the firm.

Risk Management

The board of directors should demand substance over form. For example, business and risk management strategies should strive for economic performance, not accounting performance. To promote a robust risk management process within the firm, the board should ensure sufficient upward mobility in terms of risk management careers, appropriate staff remuneration, and logical reporting relationships.

The board should set up an ethics committee (either within the board or within the firm) to require all staff to adhere to the firm's high ethical standards. The committee could also be responsible for monitoring duties to ensure that those standards are upheld.

Similar to the issue of agency risk under corporate governance, the board should ensure that performance measurement and compensation for all staff is consistent with the firm's goals and the shareholders' interests. Specifically, compensation should be determined based on performance on a risk-adjusted basis.

The board must provide approval on all major transactions after ensuring the transactions are within the established risk appetite and consistent with the firm's overall business strategy. In addition, the board should be prepared to pose probing and relevant questions to management and other staff in the context of professional skepticism. Corroborating information from a variety of sources and staff should increase the reliability and validity of the answers obtained.

The board should have a risk committee in place. Similar to the corporate governance best practice of having all members possessing a basic knowledge of the firm's business and industry, all risk committee members need to understand the technical risk issues (e.g., risk appetite, relevant time period) in order to ask appropriate questions and make informed decisions.

The risk committee should be separate from the audit committee given the different knowledge base and skills required in each area. However, it may be useful to have at least one board member on both committees to ensure that the committees are working toward the same corporate objectives.

RISK GOVERNANCE

LO 3.2: Assess the role and responsibilities of the board of directors in risk governance.

LO 3.4: Distinguish the different mechanisms for transmitting risk governance throughout an organization.

In terms of risk governance, the board has some important responsibilities that could be facilitated with the involvement of a risk advisory director. Given the specialized role of the risk management and compensation committees, the specific duties of the risk advisory director are highlighted below.

Risk Advisory Director

A risk advisory director would be a board member who is a risk specialist who attends risk committee and audit committee meetings and provides advice to increase effectiveness. The risk advisory director also meets with senior management on a regular basis and could be viewed as a liaison between the board and management. Overall, the role would involve educating members on best practices in both corporate governance and risk management.

More specific duties of the director (and the board in general) would include the review and analysis of the following:

- The firm's risk management policies.
- The firm's periodic risk management reports.
- The firm's risk appetite and its impact on business strategy.
- The firm's internal controls.
- The firm's financial statements and disclosures.
- The firm's related parties and related party transactions.
- Any audit reports from internal or external audits.
- Corporate governance best practices for the industry.
- Risk management practices of competitors and the industry.

Risk Management Committee

Using a bank as an example, the risk management committee (within the board) is responsible for identifying, measuring, and monitoring financial risks (i.e., credit, market, liquidity). The committee is responsible for approving credit facilities that are above certain limits or within limits but above a specific threshold. In addition, the committee monitors the composition of the bank's lending and investment portfolios in light of the current economic environment in terms of credit, market, and liquidity risk to determine if any changes in the portfolio composition are required.

The risk management committee usually maintains an open line of communication with the external audit, internal audit, and management teams.

Compensation Committee

As discussed previously, the existence of agency risk necessitates the board to implement a compensation committee to ensure appropriate risk taking in relation to the long-term risks assumed. The compensation committee is independent of management. Its role is to discuss and approve the remuneration of key management personnel.

Management compensation above base salary should be congruent with the goals of the other stakeholders. In that regard, the committee should avoid designing compensation plans with bonuses based on short-term profits or revenues given the relative ease in which management may manipulate those amounts. Also, there could be the absence of any guaranteed bonuses or a cap could be implemented on bonuses. Furthermore, the committee may consider introducing elements of downside risk with management compensation. For example, compensation may be deferred until longer-term results are known or there could be clawbacks of previous bonuses paid if long-term results are inconsistent with short-term results.

Stock-based compensation is a potential solution to align management and shareholder interests. However, it is not a perfect solution because there is still potential for management to take excessive risks; their upside potential is theoretically unlimited based on the stock price increase but their downside potential is limited if the stock becomes worthless. Another idea would be to provide "bonus bonds" as compensation that would be taken away should a specific regulatory ratio requirement be breached.

Audit Committee

LO 3.6: Assess the role and responsibilities of a firm's audit committee.

The audit committee (as part of the board) has traditionally been responsible for the reasonable accuracy of the firm's financial statements and its regulatory reporting requirements. It must ensure that the firm has taken all steps to avoid the risk that the financial statements are materially misstated as a result of undiscovered errors and/or fraud. In addition to the more visible verification duties, the audit committee monitors the underlying systems in place regarding financial reporting, regulatory compliance, internal controls, and risk management. In that respect, the audit committee may be able to rely on some or all of the work of the internal audit team, which usually reports directly to the audit committee.

All members of the audit committee must possess sufficient financial knowledge in order to perform in their role. This requires an understanding of the relevant accounting rules (e.g., U.S. GAAP, IFRS), financial statements, and internal controls. As a collective, there should be a proper balance of independence, knowledge of the business, and ability to ask probing and relevant questions. The audit committee is largely meant to be independent of management but it should work with management and communicate frequently to ensure that any issues arising are addressed and resolved.

Finally, there should be responsibilities for the audit committee in terms of meeting minimum (or higher) standards in areas such as legal, compliance, and risk management.

There could also be duties related to optimizing the firm's operations in terms of effectiveness and efficiency.

RISK APPETITE AND BUSINESS STRATEGY

LO 3.3: Evaluate the relationship between a firm's risk appetite and its business strategy, including the role of incentives.

A firm's risk appetite reflects its tolerance (especially willingness) to accept risk. The subsequent implementation of the risk appetite into defining the firm's risk limits sets some bounds to its business strategy and to its ability to exploit business opportunities. The board needs to develop/approve the firm's risk appetite as well as assist management in developing the firm's overall strategic plan.

There must be a logical relationship between the firm's risk appetite and its business strategy. As a result, business strategy planning meetings require input from the risk management team right from the outset to ensure the consistency between risk appetite and business strategy. For example, planning activities are often focused on maximizing the firm's profit but some planned activities may need to be eliminated or modified because they exceed the stated risk appetite. Furthermore, the scope of some planned activities may be too large in the context of the firm's total assets or equity. Consideration must also be given to the downside risks of any business strategy.

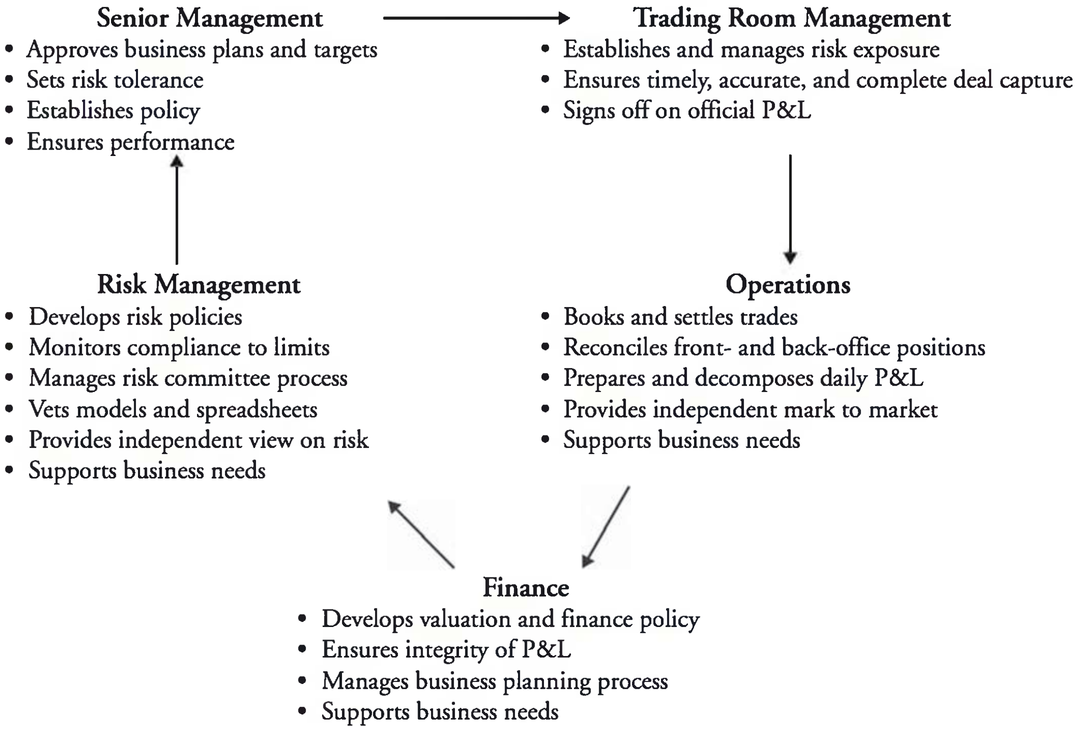
To make sure that a firm's risk management plan aligns risk appetite with business decisions, the firm should rely on its risk infrastructure while taking into account incentive compensation plans. An appropriate infrastructure should be in place to allow the firm to identify, evaluate, and manage all relevant risks. The results of incentive compensation plans should also be monitored to ensure that the firm's risk-adjusted return on capital meets the long-term expectations of stakeholders.

INTERDEPENDENCE OF FUNCTIONAL UNITS

LO 3.5: Illustrate the interdependence of functional units within a firm as it relates to risk management.

The various functional units within a firm are dependent on one another when it comes to risk management and reporting. All transactions must be recorded correctly and in the appropriate period in order to ensure the accuracy of the periodic profit and loss (P&L) statements. Using an investment bank, consider five separate units: (1) senior management, (2) risk management, (3) trading room management, (4) operations, and (5) finance. The interdependence of managing risk among these functional units is illustrated in Figure 1.

Figure 1: Interdependence


Senior Management
• Approves business plans and targets
• Sets risk tolerance
• Establishes policy
• Ensures performance
Trading Room Management
• Establishes and manages risk exposure
• Ensures timely, accurate, and complete deal capture
• Signs off on official P&L
Risk Management
• Develops risk policies
• Monitors compliance to limits
• Manages risk committee process
• Vets models and spreadsheets
• Provides independent view on risk
• Supports business needs
Operations
• Books and settles trades
• Reconciles front- and back-office positions
• Prepares and decomposes daily P&L
• Provides independent mark to market
• Supports business needs
Finance
• Develops valuation and finance policy
• Ensures integrity of P&L
• Manages business planning process
• Supports business needs

Crouhy, M., Galai, D., & Mark, R. (2014). Chapter 4: Corporate Governance and Risk Management (Figure 4-2). *The Essentials of Risk Management (2nd edition)*. New York: McGraw-Hill, 2014.

There are many examples of interdependence among the functional units. Overall, the operations unit is extremely important to all the other units in terms of generating and maintaining the data needed to manage risk. All trades are recorded and all reconciliations are performed within operations.

The finance unit develops valuation and finance policies. Those valuation policies are subsequently applied by the operations unit when it prepares asset valuations. The P&L statement (i.e., income statement) is developed by the operations and finance units and ultimately approved by trading room management. Note the consistent support of the bank's business needs by the risk management, operations, and finance units.

KEY CONCEPTS

LO 3.1

There are numerous best practices in corporate governance, including:

- Board is comprised of a majority of independent members with basic knowledge of the firm's business and industry.
- Board watches out for the interests of all stakeholders, including shareholders and debtholders who may have somewhat differing interests.
- Board is aware of any agency risks and takes steps to reduce them (e.g., compensation committee).
- Board maintains its independence from management (e.g., CEO is not the chairman of the board).
- Board should consider the introduction of a chief risk officer.

There are numerous best practices in risk management, including:

- Board should focus on the firm's economic performance over accounting performance.
- Board should promote a robust risk management process within the firm (e.g., upward mobility for risk management careers).
- Board should set up an ethics committee to uphold high ethical standards within the firm.
- Board should ensure that compensation is based on risk-adjusted performance.
- Board should approve all major transactions.
- Board should always apply professional skepticism to ask probing and relevant questions to management.
- Board should have a risk committee in place.

LO 3.2

The role of the board of directors in governance would include the review and analysis of:

- The firm's risk management policies.
- The firm's periodic risk management reports.
- The firm's appetite and its impact on business strategy.
- The firm's internal controls.
- The firm's financial statements and disclosures.
- The firm's related parties and related party transactions.
- Any audit reports from internal or external audits.
- Corporate governance best practices for the industry.
- Risk management practices of competitors and the industry.

LO 3.3

A firm's risk appetite reflects its tolerance (especially willingness) to accept risk. There is subsequent implementation of the risk appetite into defining the firm's risk limits. Ultimately, there must be a logical relationship between the firm's risk appetite and its business strategy.

LO 3.4

Two mechanisms for transmitting risk governance throughout a firm are the audit committee of the board and the use of a risk advisory director. Additionally, the role of the risk management committee and the compensation committee further transmit risk governance.

LO 3.5

The various functional units within a firm are dependent on one another when it comes to risk management and reporting. Using an investment bank as an example, areas such as valuations, the profit and loss statement, and risk policy require input from more than one of the following units: (1) senior management, (2) risk management, (3) trading room management, (4) operations, and (5) finance.

LO 3.6

The audit committee is responsible for the reasonable accuracy of the firm's financial statements and its regulatory reporting requirements. It must ensure that the firm has taken all steps to avoid the risk that the financial statements are materially misstated as a result of undiscovered errors and/or fraud. In addition to the more visible verification duties, the audit committee monitors the underlying systems in place regarding financial reporting, regulatory compliance, internal controls, and risk management.

CONCEPT CHECKERS

1. Which of the following statements about best practices in corporate governance and risk management is most accurate?
   A. The board should keep the risk committee separate from the audit committee.
   B. The board should ensure that it has the firm's chief risk officer as a member of the board.
   C. The board should focus on management's actions and their impact on the interests of the firm's shareholders.
   D. The board should focus on accounting performance instead of economic performance because of the importance of maintaining or enhancing the firm's stock price.

2. The role of the risk advisory director on the board is important in ensuring sufficient risk oversight of the firm by the board. Which of the following specific items would the risk advisory director review and analyze?
   I. Internal audit reports.
   II. Information on the firm's related parties.
   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

3. Which of the following statements regarding the firm's risk appetite and/or its business strategy is most accurate?
   A. The firm's risk appetite does not consider its willingness to accept risk.
   B. The board needs to work with management to develop the firm's overall strategic plan.
   C. Management will set the firm's risk appetite and the board will provide its approval of the strategic plan.
   D. Management should obtain the risk management team's approval once the business planning process is finalized.

4. The various responsibilities surrounding the profit and loss (P&L) statement illustrate the importance of understanding the interdependence of managing risk within a firm. Within an investment bank, which functional unit is most likely to provide final approval of the P&L?
   A. Finance.
   B. Operations.
   C. Senior management.
   D. Trading room management.

5. Which of the following statements regarding the role of the firm's audit committee is most accurate?
   A. At least one member of the audit committee must possess sufficient financial knowledge.
   B. The audit committee may consist of some members of the management team.
   C. The audit committee is only responsible for the accuracy of the financial statements.
   D. The audit committee is meant to work dependently with management.

CONCEPT CHECKER ANSWERS

1. A The risk committee should be separate from the audit committee given the different knowledge base and skills required in each area.

   Choice B is not correct because the firm's chief risk officer (CRO) is technically a member of management but does attend board meetings regularly. Although the CRO may report to management and/or the board, the CRO should not be a member of the board. Choice C is not correct because the board should consider the impact on all of the firm's stakeholders (i.e., debtholders, shareholders) and not just the shareholders. Choice D is not correct because the board should ensure that business and risk management strategies should strive for economic performance, not accounting performance.

2. C The risk advisory director should review and analyze internal audit reports and information on the firm's related parties because they are directly relevant in assessing the firm's risk level from the board's perspective.

3. B The board needs to develop/approve the firm's risk appetite as well as assist management in developing the firm's overall strategic plan.

   Choice A is not correct because the firm's risk appetite considers its willingness to accept risk. Choice C is not correct because both management and the board will set the firm's risk appetite. Choice D is not correct because management should involve the risk management team in the business planning process right from the outset to ensure the consistency between risk appetite and business strategy.

4. D Trading room management is responsible for signing off on the official P&L. Choice A is not correct because the finance unit ensures the integrity of the P&L. Choice B is not correct because the operations unit prepares and decomposes the daily P&L. Choice C is not correct because senior management does not have any responsibilities for the P&L from a risk management perspective.

5. B The audit committee consists primarily of non-management members but there may be some management members (e.g., chief financial officer).

   All members of the audit committee must possess sufficient financial knowledge. The audit committee is responsible for the accuracy of the financial statements but that alone does not comprise its main responsibility. Additionally, the audit committee monitors the underlying systems in place regarding financial reporting, regulatory compliance, internal controls, and risk management. The audit committee is largely meant to be independent of management but it should work with management and communicate frequently to ensure that any issues arising are addressed and resolved.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

WHAT IS ERM?

Topic 4

EXAM FOCUS

Enterprise risk management (ERM) is a relatively recent concept that emerged in response to moving away from the traditional approach to risk management under which each risk was assessed, managed, and mitigated separately by a specific unit within the firm. In this topic, you will gain familiarity with the concept and definitions of ERM, its benefits and costs, and the seven major components of ERM. The role of the chief risk officer can also be a critical component in the implementation and success of the ERM program across the firm. For the exam, be familiar with the three motivations of the ERM program, and understand each of the seven components of a successful ERM program.

ENTERPRISE RISK MANAGEMENT

LO 4.1: Describe enterprise risk management (ERM) and compare and contrast differing definitions of ERM.

Companies face a variety of risks that arise from company operations, including but not limited to: credit, market, liquidity, operational, business, and information technology (IT) risks. Within the traditional approach to risk management, each of these primary risk types was evaluated by a specific unit within the organization in isolation, independent of the other risk types. For example, a company's traders were responsible for managing market risk, actuaries managed insurance risk, and management analyzed business risk.

While the traditional approach may have been adequate in a less volatile market environment, it suffers from the shortcoming of ignoring the dynamic nature of risks and their interdependencies. One risk type can affect another, and risks (or their hedges) can be offsetting if viewed from the perspective of the entire company. Treating each primary risk type in isolation ignores these interdependencies and can result in inefficient and costly overhedging of risks at the firm level. In addition, the various functional units responsible for evaluating and measuring risks may all use different methodologies and formats in their risk measurements. Without a centralized risk management system, a company's senior management and its board of directors would receive fragmented information from the various units, each potentially utilizing different measurement methods.

Given the noted shortcomings of the traditional approach, an integrated and centralized framework would significantly increase the efficiency of managing company risks. Such a centralized approach is referred to as **enterprise risk management (ERM)**.

ERM Definitions

Since the concept of ERM is relatively new and is still evolving, there is a lack of a standard ERM definition. ERM is often defined as a process or activity to manage risks. For example, the following definition was provided by the Committee of Sponsoring Organizations of the Treadway Commission (COSO) in 2004:

> *"ERM is a process, effected by an entity's board of directors, management, and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its appetite, to provide reasonable assurance regarding the achievement of entity objectives."*

The International Organization of Standardization (ISO 3000) provides the following definition:

> *"Risk is the effect of uncertainty on objectives and risk management refers to coordinated activities to direct and control an organization with regard to risk."*

Both of the previous definitions contain useful ideas of ERM, but they do not define it as a value-added concept. As a result, a more useful definition of ERM is as follows:

> *"Risk is a variable that can cause deviation from an expected outcome. ERM is a comprehensive and integrated framework for managing key risks in order to achieve business objectives, minimize unexpected earnings volatility, and maximize firm value."*[1]

ERM is crucial in establishing a firm-wide, integrated set of policies, procedures, and standards. From senior management's perspective, an ERM system provides an invaluable overall risk perspective and control.

ERM Benefits and Costs

LO 4.2: Compare the benefits and costs of ERM and describe the motivations for a firm to adopt an ERM initiative.

There are three primary motivations for a firm to implement an ERM initiative: (1) integration of risk organization, (2) integration of risk transfer, and (3) integration of business processes. The respective benefits are better organizational effectiveness, better risk reporting, and improved business performance. However, implementation of an integrated firm-wide initiative is costly (both capital and labor intensive) and time-consuming. This process could last several years and requires ongoing senior management and board support.

Integration of Risk Organization: Increased Organizational Effectiveness

While most companies have many individual risk management functions, including market, credit, and various other risk units, an effective ERM strategy aggregates these risks under a centralized risk management process. Under a centralized process, the role of a chief risk officer (CRO) is often created, which reports to the company's chief executive officer (CEO) and/or the board, while the various risk management units report to the CRO. The benefit of a centralized approach is a top-down, coordinated framework that factors in the relationships and interdependencies of various risks.

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[1] James Lam, *Enterprise Risk Management: From Incentives to Controls*, 2nd Edition, (Hoboken, NJ: John Wiley & Sons, 2014), 53.

Integration of Risk Transfer: Better Risk Reporting

Under the traditional, non-ERM approach, the various risks facing the company were evaluated by individual units within the organization, where each unit managed its own risk. For example, market risk was managed through derivatives, while operational risk was managed with insurance. This approach is useful in mitigating isolated risks, but it does not account for diversification within or across the various risk types, which could lead to over-hedging of risks or taking out excessive insurance coverage. Further, since no one unit is responsible for overall risk reporting, reporting of risks can be inconsistent and contradictory.

By contrast, ERM enables the company to take a holistic view of all risks and risk hedges used in order to hedge only those undesirable residual risks that still remain after factoring in diversification across risks. Risks are categorized under a risk dashboard of key risks, which includes an enterprise level description of key exposures, total losses, policy exceptions, and even early warning indicators. Senior management and the board are, therefore, able to take a big picture view of the interplay between each of the risks and can take appropriate measures to mitigate any residual risk.

Integration of Business Processes: Improved Business Performance

The third element of ERM is integrating risk management into the company's business processes. ERM can optimize business performance through business decisions, including capital allocation, product development and pricing, and efficient allocation of resources. This optimization results in reduced risk and only takes on the most profitable risks (i.e., maintains only those risks whose cost is less than the benefit of the corresponding project). Traditional risk measures such as value at risk (VaR) and risk-adjusted return on capital (RAROC) have been increasingly used to measure not only market risk but also credit and operational risk, while alternative risk measures such as credit derivatives are increasingly used to mitigate additional risks. The end result is a reduction in losses, lower earnings volatility, increased earnings, and higher shareholder value.

An effective ERM initiative allows company management to understand the major risk exposures and to set up adequate risk reporting. At the same time, auditors and regulators assess the company's ERM and set the necessary capital and compliance requirements for the board and senior management. In order to adequately address these requirements, the role of a "risk champion" has become more widespread, typically in the position of a CRO.

THE CHIEF RISK OFFICER

LO 4.3: Describe the role and responsibilities of a chief risk officer (CRO) and assess how the CRO should interact with other senior management.

The specific role of the CRO was created in the early 1990s in response to the emergence of new financial instruments and the integration of capital markets. The CRO is responsible for all risks facing a company, including market, credit, operational, and liquidity risks, and specifically responsible for developing and implementing an ERM strategy. The role is prominent among financial firms, firms with significant investment activities or foreign operations, and energy firms.

The CRO is a top-level executive responsible for overall risk management in a centralized role. Reporting to the CRO typically are the heads of the various risk functions, including the heads of credit, market, operational, and insurance risks. The CRO provides overall leadership, vision, and direction for ERM and develops a framework of management policies, including setting the overall risk appetite of the firm. This includes measuring and quantifying risks and setting risk limits, developing the requisite risk systems, and communicating a clear vision of the firm's risk profile to the board and to key stakeholders.

Within the firm's hierarchy, the CRO typically reports to the CEO or the chief financial officer (CFO); however, the role is placed somewhere between the CEO/CFO and the board. Often there is a dotted line relationship with dual reporting to both the CEO/CFO and to the board. The dotted line relationship is intended to minimize any potential friction between the CRO and the firm's CEO or other top executives due potentially to excessive risk taking, regulatory issues, or outright fraud by the CEO or executives. In order to properly establish the reporting structure, it is important that the role of the CRO is clearly defined with clear goals and responsibilities for hiring and firing decisions.

Of course, the creation of the CRO role is not the only solution to establishing top-level risk oversight. The firm's audit committee could also take on this role; however, the audit functions are typically already stretched in their capacity to take on additional oversight roles. The centralization of all risk responsibilities could also be assigned to the CEO or CFO; however, there is strong support for establishing a separate oversight function in the role of the CRO who has experience and focused responsibility for risk management.

Over the last couple of decades, the CRO position, with its focused approach to risk management, has provided greater visibility and effectiveness to the role and to ERM. The role now represents the culmination of the risk executive functions with escalating salaries, and a company's CRO is often a contender for the highest executive roles including the role of the CEO. An ideal CRO possesses five critical skills: (1) leadership, (2) power of persuasion, (3) ability to protect the firm's assets, (4) technical skills to understand all risks, and (5) consulting skills to educate the board and business functions on risk management.

ERM FRAMEWORK COMPONENTS

LO 4.4: Distinguish between components of an ERM program.

There are seven components of a strong ERM framework: (1) corporate governance, (2) line management, (3) portfolio management, (4) risk transfer, (5) risk analytics, (6) data and technology resources, and (7) stakeholder management.

Corporate governance is critical in the implementation of a successful ERM program and ensures that senior management and the board have the requisite organizational practices and processes to adequately control risks. Corporate governance practices have evolved considerably through recent regulatory initiatives including the Turnbull Report and the Sarbanes-Oxley Act. A successful corporate governance framework requires that senior management and the board adequately define the firm's risk appetite and risk and loss tolerance levels. In addition, management should remain committed to risk initiatives and ensures that the firm has the required risk management skills and organizational structure to successfully implement the ERM program. An effective framework also requires that all key risks are successfully integrated into the ERM program and those responsible for implementing the program have clearly defined risk roles and responsibilities, including the role of the CRO. Oversight, audit, and monitoring targets are also crucial components of the ERM governance process.

Line management is the management of activities that relate directly to producing a firm's products and services. Line management is critical as it integrates business strategy into corporate risk policy, assesses the relevant risks, and incorporates them into pricing and profitability decisions. The assessment process should include adequate due diligence to determine which risks line managers can accept without senior management or board approval. In terms of addressing relevant risks, managers should include the cost of risk capital and expected losses in decisions about product pricing or investment returns.

Portfolio management provides a holistic view of the firm's risks if these risks are viewed as individual components of the aggregate risks facing the firm. Active portfolio management aggregates risk exposures and allows for diversification of risks (partly through offsetting risk positions) and prudent monitoring of risk concentrations against preset limits. Firms that manage each of their financial risks independently will need to integrate these risks into a comprehensive ERM process to optimize firm risk and return.

Risk transfer reduces or transfers out risks that are either undesirable risks or are desirable but considered concentrated (i.e., excessive risks). Concentrated risks can be especially risky for a company, and it is crucial that these positions are adequately monitored and mitigated. Risks could also be transferred to third parties if it is more cost effective to manage them externally. Risks can be offloaded through derivatives, insurance, and hybrid products. Natural hedges within the portfolio could also be incorporated into the risk transfer process to reduce hedging and insurance costs, even in the absence of third-party protection.

Risk analytics quantifies risk exposures for use in risk analysis, measurement, and reporting. Many of the risks facing the firm can be quantified including credit, market, and operational risk. Risk analytics can be used to calculate the cost-effective way of reducing risk exposures. It is also useful in evaluating the cost of managing risks in-house or externally as long as the cost of managing them externally is cheaper. The analysis and quantification of various risks can ultimately increase shareholder value, boosting net present value (NPV) and economic value added (EVA).

Data technology and resources improve the quality of data used in evaluating risks. Management faces the challenge that various systems used by the firm capture different price, volatility, or correlation metrics. Data technology and resources can mitigate these challenges by being incorporated into the firm's ERM program. Even if the technological resources available to the firm are not perfect, firms should incorporate them into the ERM system as early as possible.

Stakeholder management facilitates communicating a firm's internal risk management process to external stakeholders, including shareholders, creditors, regulators, and the public. The information shared with stakeholders is also important for rating agencies and analysts as they use this information in developing their research and credit opinions. A firm's internal risk management should be transparent to stakeholders, should provide adequate assurances that management follows prudent risk practices, and should include regular updates on the key risk factors facing the organization.

KEY CONCEPTS

LO 4.1

An integrated and centralized approach under ERM is significantly more effective in managing a company's risks than under the traditional silo approach of managing and centralizing risks within each risk/business unit. ERM is a comprehensive and integrated framework for managing a firm's key risks to meet business objectives, minimize unexpected earnings volatility, and maximize firm value.

LO 4.2

The key motivations of an ERM initiative include integration of risk organization, integration of risk transfer, and integration of business processes, which lead to increased organizational effectiveness, better risk reporting, and improved business performance, respectively.

LO 4.3

The chief risk officer (CRO) is responsible for all risks facing a company, including market, credit, and operational risks and is responsible for developing and implementing an ERM strategy. The CRO provides overall leadership for ERM and develops policies and standards, including setting the firm's overall risk appetite, measuring and quantifying risks and setting risk limits, and developing risk systems.

The CRO generally reports to the CEO or CFO but could also have a dotted line relationship to both the CEO/CFO and to the board to minimize any potential friction between the CRO and the CEO/CFO (due to excessive risk taking, regulatory issues, or fraud).

An ideal CRO possesses five critical skills: (1) leadership, (2) power of persuasion, (3) ability to protect the firm's assets, (4) technical skills to understand all risks, and (5) consulting skills to educate the board and business functions on risk management.

LO 4.4

A strong ERM framework has seven main components: (1) corporate governance, (2) line management, (3) portfolio management, (4) risk transfer, (5) risk analytics, (6) data and technology resources, and (7) stakeholder management.

CONCEPT CHECKERS

1. The basis of enterprise risk management (ERM) is that:
   - A. risks are managed within each risk unit but centralized at the senior management level.
   - B. the silo approach to risk management is the optimal risk management strategy.
   - C. risks should be managed and centralized within each risk unit.
   - D. it is necessary to appoint a chief risk officer to oversee most risks.

2. Jimi Chong is a risk analyst at a mid-sized financial institution. He has recently come across an article that described the enterprise risk management (ERM) process. Chong does not believe this is a well-written article, and he identified four statements that he thinks are incorrect. Which of the following statements identified by Chong is actually correct?
   - A. One of the drawbacks of a fully centralized ERM process is over-hedging risks and taking out excessive insurance coverage.
   - B. Effective ERM has three key benefits: improved business performance, better risk reporting, and stronger stakeholder management.
   - C. Managing downside risk and earnings volatility are optional ERM strategies.
   - D. A prudent ERM strategy allows a firm to accept more of the profitable risks.

3. Which of the following statements regarding the responsibilities of the chief risk officer (CRO) is least accurate?
   - A. The CRO should provide the vision for the organization's risk management.
   - B. In addition to providing overall leadership for risk, the CRO should communicate the organization's risk profile to stakeholders.
   - C. Although the CRO is responsible for top-level risk management, he is not responsible for the analytical or systems capabilities for risk management.
   - D. The CRO may have a solid line reporting to the CEO or a dotted line reporting to the CEO and the board.

4. Luke Drake has been recently appointed as the chief risk officer (CRO) of a non-profit organization. Drake is looking to implement a comprehensive enterprise risk management (ERM) program and had several discussions with senior management on this topic. During one of these discussions, Drake made the following statements:

   Statement 1: *"Risk analytics is a key component of ERM and refers to the integration of risk management into the revenue generating activities of the organization."*

   Statement 2: *"While an organization can hedge desirable risks, it is unable to hedge undesirable risks."*

   Is Drake correct regarding risk analytics and risk hedging?

	Risk analytics	Risk hedging
A.	Correct	Incorrect
B.	Incorrect	Incorrect
C.	Correct	Correct
D.	Incorrect	Correct

5. Allen Richards sits on the board of directors of a Canadian financial institution. Richards read the following statements in a presentation made to the board of directors by management on the institution's enterprise risk management strategies:

Statement 1: *"To manage undesirable risks, the institution could use third-party protection, including insurance products."*

Statement 2: *"Although third-party protection is expensive, this is a cost of business, and it is not possible to reduce these costs."*

Richards believes both of these statements are incorrect. Richards' assessment is accurate with respect to:

A. Statement 1 only.
B. Statement 2 only.
C. Both statements.
D. Neither statement.

CONCEPT CHECKER ANSWERS

1. **A** The basis of enterprise risk management (ERM) is that risks are managed within each risk unit but centralized at the senior management level.

   The traditional approach to risk management was the silo approach, under which each firm unit was responsible for managing its own risks, setting its own policies and standards, without coordination between the risk units. ERM is a superior approach because management benefits from an integrated approach to handling all risks (for example, management can see risks within the firm that cancel out and, therefore, do not need to be separately hedged). It is common, but not necessary, to appoint a chief risk officer to oversee all risks under ERM.

2. **D** A strong ERM strategy allows a firm to accept more of the profitable risks and reject unprofitable risks.

   Over-hedging risks and taking out excessive insurance coverage are issues faced by companies that do not have an integrated ERM strategy. In addition to improved business performance and better risk reporting, the third benefit of effective ERM is improved organizational effectiveness. Managing downside risk and earnings volatility are strategies typical of companies with a defensive approach to risk management, whereas effective ERM focuses on optimizing performance, influencing pricing, and allocating resources effectively.

3. **C** While it is accurate that the CRO is responsible for top-level risk management, he is also responsible for the analytical or systems capabilities for risk management.

4. **B** Both of Drake's statements are incorrect. Line management, not risk analytics, refers to the management of activities that relate directly to producing a firm's products and services. Line management is critical as it integrates business strategy into corporate risk policy.

   Through risk transfer, management can utilize a successful ERM program to transfer out both undesirable risk and desirable, concentrated risks. Hedging is typically done with derivatives, insurance, and hybrid products.

5. **B** Richards was wrong in identifying Statement 1 as being incorrect. Statement 1 is, in fact, correct because when managing undesirable risks, an institution could use third-party protection, including various hedges and insurance products.

   Richards accurately identified Statement 2 as being incorrect. While it is true that third-party protection can be expensive, by incorporating natural hedges in a risk portfolio, the institution could reduce its hedging and insurance costs.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

RISK MANAGEMENT, GOVERNANCE, CULTURE, AND RISK TAKING IN BANKS

Topic 5

EXAM FOCUS

This topic begins by discussing how a bank's optimal level of risk exposure is tied to a target default probability or credit rating. From there, it examines the impact of a bank taking on too little or too much risk compared to its optimal level, along with actions that may add or destroy value for the bank. For the exam, understand how banks determine their optimal level of risk exposure and be able to describe implications for risk-taking activities. In addition, understand the limitations of and challenges to effective risk management as well as the impacts of governance, incentives, and culture on a bank's risk profile and performance.

OPTIMAL LEVEL OF RISK

LO 5.1: Assess methods that banks can use to determine their optimal level of risk exposure, and explain how the optimal level of risk can differ across banks.

Methods to Determine Optimal Level of Risk Exposure

Targeting a certain default probability or targeting a specific credit rating. In general, a bank should not always aim to earn the highest credit rating possible (e.g., AAA). Earning the AAA rating would likely involve a large opportunity cost as the bank would have to forego risky projects that could otherwise earn high profits. For example, assume that the necessary research and analysis has revealed that a bank's optimal level of risk exposure is represented by an AA credit rating (i.e., a very low probability of default—less than 0.08%). In that case, the bank should target the appropriate probability of default in determining its optimal level of risk exposure. Aiming for AAA may constrain the bank's risk-taking ability and reduce its returns due to lost profitable projects. Aiming for BBB may result in lost customers due to the perception that the bank is engaging in excessive risk-taking activities.

Sensitivity analysis or scenario analysis. Alternatively, a bank could determine its optimal level of risk exposure by the impact of specific shocks. For example, there could be adverse impacts on the value of a bank due to changes in one or more of the following items: interest rates, foreign exchange rates, or inflation. Measuring the cumulative impact on the bank's value for a given scenario may be problematic because the individual shocks may work in opposition to one another (i.e., one shock may decrease value while the other shock may increase value).

How the Optimal Level of Risk Can Differ Across Banks

The optimal level of risk depends on the specific focus of the bank's activities, so it will differ among banks. For example, a bank that is focused on deposits, relationship lending customers, or both would usually set the level of risk lower and target a higher credit rating in order to satisfy its customers' desire for safety. The same would occur if the bank is a frequent counterparty in long-term derivatives transactions; the other counterparties would want to ensure the bank is a safe and reliable counterparty to deal with. In contrast, a bank that is focused more on transactional activities would usually set the level of risk higher and target a lower credit rating.

The relationship between the value of a bank and its credit rating is concave, which suggests that there is a maximum or optimal value at a specific credit rating. At a high target rating (e.g., A rated), the value of the bank will decrease significantly if the bank takes on more risk than is optimal, and the value will only increase slightly if the bank takes on more risk toward the optimal level. At a lower target rating (e.g., BB rated), the value of the bank will also decrease significantly if the bank takes on more risk than is optimal, but the value will increase significantly as it takes on more risk toward the optimal level.

RISK-TAKING IMPLICATIONS

LO 5.2: Describe implications for a bank if it takes too little or too much risk compared to its optimal level.

Overall, banks need to take on an optimal amount of risk (usually not zero) in order to maximize shareholder value while satisfying the constraints imposed by bank regulators.

In general terms, if a subject bank takes on too little risk, it may fail to capitalize on enough profitable opportunities and, therefore, may generate suboptimal returns for its shareholders. Ultimately, too little risk may decrease the value of the subject bank. On the other hand, if a subject bank takes on too much risk, it may become distressed, which could result in losses for other banks that are counterparties to the subject bank that is defaulting on unsecured obligations. As more banks suffer similar losses, there is an increasing threat to the stability of the financial system. Ultimately, too much risk may also decrease the value of the subject bank.

Consider a general situation where a bank is valued for its ability to provide safe and liquid investments to its customers. If the bank takes on too much risk, then that may impair its ability to provide safe and liquid investments. As mentioned earlier, too much risk may reduce the value of the bank.

LO 5.3: Explain ways in which risk management can add or destroy value for a bank.

If incremental changes in risk taken do not result in much change in the value of a bank, then investing in risk management is destroying the bank's value due to the fixed cost of having a risk management department. However, if taking on incremental risk would otherwise result in excessive total risk and a significant decrease in the bank's value, then there is added value in having risk management policies to prevent the bank from taking on excessive risk. In other words, if there is a very high cost of having incremental risk above the optimal level, then there is value in having a risk management department to ensure compliance with specific risk limits.

If a bank adopts a risk management process that is inflexible in order to manage the bank's risk below a set acceptable threshold level, it may end up controlling risk, but not allowing for any value creation. In contrast, a more flexible and properly functioning risk management process would allow a bank to take on profitable risks and take advantage of investment opportunities that could increase its value. In that sense, risk management becomes a crucial part of the bank's operations that aims to create policies intended to increase the bank's value.

Different business units are unable to determine for certain whether the risks they are taking will add or destroy value to the firm as a whole. That is because the total amount of risk that the bank is able to take is dependent on all of the risks taken by the various business units. As a result, the risk management function can add value by requiring all business units to take the perspective of the entire bank when making decisions regarding risks. This perspective will assist the bank in operating at its optimal level of risk.

RISK MANAGEMENT CHALLENGES AND LIMITATIONS

LO 5.4: Describe structural challenges and limitations to effective risk management, including the use of VaR in setting limits.

Limitations of Hedging

Risk management through hedging alone will not result in risk management becoming a passive activity due to (1) risk measurement technology limitations, (2) hedging limitations, and (3) risk-taker incentive limitations.

Real-time risk measures do not exist for entire banks although they do exist for certain banking activities. Additionally, risk measures are far from perfect and can result in inaccurate computations. A potential solution to underestimating risk would be to create a risk buffer by placing a limit significantly below the target for any given risk measure. Finally, excessive optimism and the effects of group decision making could result in key issues being overlooked.

In theory, hedging would reduce risk perfectly if a bank was able to measure its risk perfectly. However, in practice, many risks are nearly or entirely impossible to hedge (e.g., terrorism risk), and some hedges are imperfect because of the inability to perfectly match the hedging vehicle with the underlying asset to be hedged.

Some risk takers within the bank (e.g., traders) are motivated to maximize their compensation by taking excessive risks that may ultimately reduce the value of the bank. Limitations in risk measurement tools may allow such activities to occur without the knowledge of the bank's management.

As a result, the bank must actively measure, monitor, and manage its risk on an on-going basis.

Role of Risk Management Within the Bank

Ideally, effective risk management would require that the risk management function within a bank be independent of the activities of its business lines. However, it is not possible for risk management merely to have a verification function. For example, risk management also involves advising whether to accept or reject a risky project based on established risk limits. There must be a separation between the manager to whom the risk manager reports and the manager of the business line that he is monitoring. However, if the risk manager aspires to work in that business line in the future, then there may be a problem with independence.

Another key point is that if the risk management process is viewed as a form of internal policing, then the necessary dialogue between risk managers and business unit managers will not exist. Specifically, it will be difficult for risk managers to obtain information and understand the business units' strategies. The risk managers will probably not be given the necessary information to assess the bank's risks, thereby potentially causing them to make incorrect risk assessments (e.g., underestimation) and not enabling them to propose mitigation procedures in a timely fashion.

Value at Risk

A unit within a bank that uses the value at risk (VaR) measure in setting limits must consider its ability to adjust its VaR by trading efficiently (i.e., quickly and at a low cost). If the bank is able to do so, then it can stay near the limit. If it is unable to do so, then it will want to operate at a lower level of risk in order to take advantage of opportunities that may arise later on. The same could conceivably occur in other units so that, overall, the bank is not making optimal use of its ability to take risk, potentially resulting in lower profits.

Banks often break down their risks into three categories: (1) market, (2) credit, and (3) operational risk. In measuring risk at the firm level, the resulting VaR is not likely to account for all risks, especially operational. Many banks earn non-interest income (e.g., service charges, set-up fees); such income is variable in nature and is typically low if there are loan losses incurred by the bank. Therefore, non-interest income must be specifically modeled in obtaining a more accurate measure of firmwide VaR. Interest rate risks pertaining to a bank's liabilities are usually not included in firmwide VaR measures. Additionally, credit VaR measures do not consistently take into account the risks pertaining to unexpected interest rate and credit spread changes. Finally, firmwide VaR measures often do not consider funding liquidity risk. Funding liquidity risk refers to a sudden reduction in funding to the bank, which often necessitates a sale of assets at a discount or loss.

The aggregation of market, credit, and operational risks in arriving at a firmwide risk measure needs to consider the correlation estimates between such risks; the higher the correlations, the higher the firmwide VaR (and vice versa). Unfortunately, there is usually insufficient data available to make such estimates accurately. Furthermore, errors in computing such estimates may result in the bank holding insufficient capital and exceeding its targeted risk of default.

Different types of risk will lead to differing statistical distributions. For example, market risk is usually modeled reasonably accurately using the normal (symmetrical) distribution, despite market risk having fatter tails. It is relatively easy to sum up the risks that follow a normal distribution. However, credit and operational risks have distributions that are both fat-tailed and very skewed. As a result, it is much more challenging to add up risks that follow a non-normal distribution.

When examining a daily VaR level, for example, of 0.08% (corresponding approximately to the probability of default for a bond rated AA), there is the issue of not having enough history to properly determine if the VaR level is unbiased, biased upward, or biased downward. In comparison, a 5% daily VaR suggests that it will be exceeded about 13 times annually (given 250 trading days), so empirical results (e.g., exceeded more or less than 13 times) can be used to test the underlying assumptions.

Similarly, unknown risks have no impact when VaR is estimated at a probability level that is not exceedingly low. Unknown risks become an issue if VaR is estimated at an extremely low level such as 0.08%. Losses at such a low VaR level would be due to extremely rare events. In that case, analyzing historical data is insufficient because there would not be enough historical data spanning a long enough period to determine an accurate measure of extreme losses that have a 0.08% chance of occurring.

BANK RISK PROFILE AND PERFORMANCE

LO 5.5: Assess the potential impact of a bank's governance, incentive structure, and risk culture on its risk profile and its performance.

Governance

In general, it is difficult to demonstrate that a bank's governance has a significant impact on its risk profile and performance. First, there is very limited data on how the risk function operates in banks. Second, risk function characteristics are affected by the bank's risk appetite in addition to governance. For example, it may be optimal for a bank not to carry much risk based on the characteristics of its risk function. In fact, for such a bank it may be very expensive to carry too much risk. Therefore, by having risk management policies that promote low risk, one might incorrectly conclude that carrying low risk is a result of good governance. Third, it is possible that at the firm level, poor performance will occur even in the presence of strong governance. A negative outcome is not always indicative of taking on too much risk or poor governance. It is possible that an extremely low probability event occurred that was already considered by the bank in setting risk.

One study by Lingel and Sheedy (2012)[1] looks at the returns of the 60 largest publicly traded banks between 2004 and 2010 as well as the role of the chief risk officer (CRO). The study demonstrates that stronger governance in one year leads to lower risk (in terms of stock return volatility and worst weekly return) in the following year. It also demonstrates that banks that have CROs with higher status (e.g., one of the top executives, one of the most highly paid) have lower risk. However, there is no evidence that such stronger governance leads to higher performance in terms of ex-post returns.

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[1] Lingel, Anna, and Elizabeth Sheedy. "The Influence of Risk Governance on Risk Outcomes—International Evidence" (working paper, Macquarie University, 2012).

At the same time, there is some evidence of the impact of governance on risk and performance. Some studies have focused on the CRO centrality variable (CRO compensation as a percentage of CEO compensation) whereby a higher CRO centrality leads to lower volatility and higher performance. Other studies have determined that banks performed better where the CRO reports to the board instead of the CEO. Finally, one study by Berg (2014)[2] considers a situation at a bank where loan officers are paid bonuses based on loan volumes generated. By adding a risk management element through the monitoring of loan decisions, there is empirical evidence that the default rate on the loans decreases as a result.

Incentive Structure

In general, incentives must be designed so that they do not merely reward managers for the performance of their respective business units alone. Incentives should reward managers for taking risks that create value for the overall bank while at the same time penalize them for taking risks that destroy value.

In designing incentives to compensate management, the concept of risk capital needs to be considered. Risk capital is the amount of capital a bank holds in order to support its risk appetite. Therefore, the cost of acquiring more equity capital to support the risks taken by the bank has to be considered when deciding whether or not to take a risk. If the cost is too high, management may decide against taking the risk.

Incentives are not perfect and cannot be so precise that they properly reward managers for every possible scenario. Some scenarios that were completely unexpected may occur, and not all risks can be properly identified or quantified.

Risk Culture

Two studies have been conducted that pertained to using employee surveys to determine the attractiveness of working at certain companies. One of these studies concluded that companies where managers were perceived as honest and trustworthy were more profitable and were given higher valuations. The other study concluded that shareholder governance improvements would change a firm's culture from focusing on employee integrity and customer service to focusing on end results. From a performance perspective, the shareholders will benefit from the improved governance, but some of those benefits will be subsequently lost as a result of the firm's culture change.

The following three examples illustrate the impact of corporate culture on risk management in the context of a bank.

Example 1: A loan officer's role is to decide whether or not to grant a loan based on the assessed risk of the applicant using the written and verbal information obtained. The loan officer is compensated based on the number and the size of the loans granted.

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[2] Berg, Tobias. "Playing the Devil's Advocate: The Causal Effect of Risk Management on Loan Quality" (working paper, Bonn University, 2014).

One form of corporate culture may be very restrictive by severely reducing the reliance on the loan officer's judgment and, instead, relying on statistical tools to automate loan decisions. That may not be an optimal outcome for the bank because it would ignore the qualitative information that the loan officer may obtain, which may result in a different decision (i.e., automated loan decision making may result in reduced profits by granting loans that should not have been granted or by not granting loans that should have been granted). Another form of corporate culture may be less restrictive by only moderately reducing the reliance on the loan officer's judgment and also relying on internal controls (e.g., peer reviews of loan decisions) and corporate culture (e.g., promoting only the best interests of the bank).

Example 2: A corporate culture that has traders constantly fighting with risk managers when questioned would make it difficult for the risk managers to properly assess risk positions and possible mitigation activities.

Example 3: A manager from another team notices that a trader has taken a position that will always be unprofitable for the bank as a whole but will be profitable to the trader if it is successful. The trader's supervisor does not notice it, and because no limits have been breached, risk management does not notice it either. In one culture, the manager may remain silent because he is not responsible for the activities of that team. In a different culture, the manager may attempt to discuss the situation with the trader or the supervisor. A bank with the latter culture is likely engaging in risk-taking activities that improve the bank's performance and increase its value.

Finally, one of the risk culture studies attempted to show the link between culture and risk outcomes. It hypothesized that a strong culture should lead to greater consistency and should serve as a control mechanism. In turn, the stronger control mechanism should result in less variability in outcomes. The study compared the volatility of unexpected performance and the strength of corporate culture, and the result was a strong negative relation between both variables.

KEY CONCEPTS

LO 5.1

Methods to determine the optimal level of risk exposure include targeting a certain default probability or credit rating and sensitivity or scenario analysis. In targeting a certain default probability or credit rating, a bank should not always aim to earn the highest credit rating possible because the rating would likely involve a large opportunity cost as the bank would have to forego risky projects that could otherwise provide high profits. Sensitivity or scenario analysis involves a bank determining its optimal level of risk exposure by the impact of specific shocks. There would be an analysis of the adverse impacts on the value of a bank due to changes in interest rates, foreign exchange rates, inflation, et cetera.

The optimal level of risk depends on the specific focus of the bank's activities (e.g., lending, deposits, derivatives), so it will differ among banks.

LO 5.2

Banks need to take on an optimal amount of risk in order to maximize shareholder value while satisfying the constraints imposed by bank regulators. If a bank takes on too little risk compared to its optimal level, it may not generate sufficient returns for its shareholders, which could decrease the value of the bank. Taking on too much risk may also decrease the value of a bank.

LO 5.3

Investing in risk management might not be worth its cost if incremental changes in risk taken do not result in much change in the value of a bank. On the other hand, risk management may add value if taking on incremental risk would otherwise result in excessive total risk and a significant decrease in the value of a bank.

If a bank adopts an inflexible risk management process in order to manage the bank's risk below a set acceptable threshold level, it may not allow for any value creation. In contrast, a more flexible risk management system may allow the bank to take on profitable risks and take advantage of investment opportunities that could increase its value.

The risk management function of a bank can add value by requiring business units to take the perspective of the entire bank when making decisions regarding risks.

LO 5.4

Risk management through hedging alone will not result in risk management becoming a passive activity due to (1) risk measurement technology limitations, (2) hedging limitations, and (3) risk taker incentive limitations.

Ideally, the risk management function within a bank would be independent of the activities of the business lines. However, risk management involves both a verification function and advising on whether to accept or reject a risky project based on established risk limits.

Therefore, such independence is difficult to achieve in practice. In addition, if the risk management process is viewed as a form of internal policing, then the necessary dialogue between risk managers and business unit managers will not exist.

All individual banking units must consider their ability to adjust their VaR by trading efficiently to ensure that, overall, the bank is making optimal use of its ability to take risk and maximizing its profits.

Firmwide VaR is not likely to account for all of the bank's risks, especially operational risks. The aggregation of market, credit, and operational risks in arriving at a firmwide risk measure needs to consider the correlation estimates between such risks, although in practice, there is usually insufficient data available to make such estimates accurately. Different types of risk will lead to differing statistical distributions. For example, market risk can be approximated by a normal distribution, but credit and operational risks follow a non-normal distribution, which makes them more challenging to quantify.

LO 5.5

It is difficult to demonstrate that a bank's governance has a significant impact on its risk profile and performance for three main reasons. First, very limited data exists on how the risk function operates in banks. Second, risk function characteristics are also affected by the bank's risk appetite (in addition to governance). Third, it is possible that at the firm level, poor performance will occur even in the presence of strong governance.

Incentives must be designed so that they do not merely reward managers for performance based on their respective business units alone. Incentives should reward managers for taking risks that create value for the overall bank while at the same time penalize them for taking risks that destroy value.

Two studies examined the impact of culture. One of these studies concluded that companies where managers were perceived as honest and trustworthy were more profitable and were given higher valuations. The other study concluded that shareholder governance improvements would change a firm's culture from focusing on employee integrity and customer service to focusing on end results.

CONCEPT CHECKERS

1. Which of the following statements regarding the optimal level of risk exposure is correct?
   A. A bank should aim to earn the highest credit rating possible.
   B. A bank that is focused on deposit customers would usually set its level of risk higher.
   C. A bank that is focused on transactional activities would usually target a lower credit rating.
   D. A bank and its credit rating have a convex relationship, meaning that there is a maximum value at a specific credit rating.

2. Which of the following statements regarding the amount of risk taken by a bank and the impact on the value of a bank is most likely correct?
   A. Banks need to take on a small amount risk in order to maximize shareholder value while satisfying the constraints imposed by bank regulators.
   B. Banks that are conservative in practice and take on less risk will always end up generating more value because they avoid incurring losses that would be associated with taking on more risk.
   C. Banks that are valued for their ability to provide liquid investments to their customers should take on less risk in order to maximize value.
   D. Banks that are conservative in practice typically assume an optimal amount of risk of zero.

3. In which of the following situations would the existence or addition of an independent risk management department add value to a bank?
   A. When there is a low cost to the bank of having incremental risk above the optimal level.
   B. When there are multiple business units within a bank, all guided by specific risk objectives of their respective units.
   C. When the risk management process is flexible and consistently succeeds in managing the bank's risk below the set acceptable threshold level.
   D. When the fixed costs of having a risk management department outweigh the benefits.

4. Which of the following risks is/are least likely to be accounted for in a bankwide value at risk (VaR) measure?

   I. Credit risk and market risk.
   II. Operational risk and funding liquidity risk.

   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

5. Which of the following statements regarding the impact of a bank's governance, incentive structure, and risk culture on its risk profile and performance is correct?
   A. Having stronger governance through a chief risk officer does not lead to higher returns.
   B. An appropriate incentive plan should be designed to reward managers for performance based solely on their respective business units.
   C. When managers are perceived as honest and trustworthy, there is no impact on a company's profit or valuation.
   D. The link between culture and risk outcomes demonstrates that there is a strong positive relation between unexpected performance and the strength of corporate culture.

CONCEPT CHECKER ANSWERS

1. **C** A bank that is focused more on transactional activities would usually set the level of risk higher and target a lower credit rating.

   Response A is not correct because a bank should not always aim to earn the highest credit rating possible. Earning such a rating would likely involve a large opportunity cost as the bank would have to forego risky projects that could otherwise provide high profits. Response B is not correct because a bank that is focused on deposit customers would usually set the level of risk lower and target a higher credit rating in order to satisfy its customers' desire for safety. Response D is not correct because the relationship between the value of a bank and its credit rating is *concave*, which suggests that there is a maximum or optimal value at a specific credit rating.

2. **C** When a bank is valued for its ability to provide safe and liquid investments to its customers, it should not take on too much risk because that may impair its ability to provide safe and liquid investments and may ultimately reduce the value of the bank.

   A bank needs to take on an *optimal* amount of risk in order to maximize shareholder value while satisfying the constraints imposed by bank regulators. In theory, the optimal amount may be zero, although in practice, that is rarely the case. If a bank takes on too little risk, it may fail to capitalize on enough profitable opportunities and, therefore, generate suboptimal returns for its shareholders. Ultimately, too little risk may lower the value of the bank.

3. **B** The total amount of risk that the bank is able to take is dependent on all of the risks taken by the various business units. As a result, the risk management function can add value by requiring the business units to take the perspective of the entire bank when making decisions regarding risks.

   If there is a very high cost of having incremental risk above the optimal level, then there is value in having a risk management department to ensure compliance with specific risk limits. If there is a very low cost of having incremental risk above the optimal level, then the fixed costs of having a risk management department may outweigh the benefits, thereby destroying value for the bank.

   If a bank has a risk management process that is very inflexible in order to manage the bank's risk below a set acceptable threshold level, it may end up controlling risk but not allowing for any value creation.

4. **B** Banks often break down their risks into three categories: market, credit, and operational. In measuring risk at the firm level, the resulting VaR is most likely not to account for all of the operational risk. In addition, firmwide VaR measures often do not consider funding liquidity risk, the sudden reduction in funding to the bank, which often necessitates a sale of assets at a discount or loss.

5. **A** One risk culture study shows that banks that have chief risk officers with higher status have lower risk. However, there is no evidence that such stronger governance leads to higher performance in terms of ex-post returns.

   Response B is not correct. Incentives should not merely reward managers for performance based on their respective business units alone. They should reward managers for taking risks that create value for the overall bank while at the same time penalize them for taking risks that destroy value. Response C is not correct. One study concluded that companies were *more profitable* and *were given higher valuations* when managers are perceived as honest and trustworthy. Response D is not correct. One study on the link between culture and risk outcomes demonstrates that there is a strong *negative* relation between unexpected performance and the strength of corporate culture.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

FINANCIAL DISASTERS

Topic 6

EXAM FOCUS

These case studies illustrate a number of financial and operational risk management failures. Specifically, we will examine cases involving misleading reporting, large unexpected market movements, and inappropriate customer conduct. Pay close attention to the causes of these financial disasters and how they could have been prevented. You should be prepared to handle questions on these recurring themes.

LO 6.1: Analyze the key factors that led to and derive the lessons learned from the following risk management case studies:

- Chase Manhattan and their involvement with Drysdale Securities
- Kidder Peabody
- Barings
- Allied Irish Bank
- Union Bank of Switzerland (UBS)
- Société Générale
- Long Term Capital Management (LTCM)
- Metallgesellschaft
- Bankers Trust
- JPMorgan, Citigroup, and Enron

MISLEADING REPORTING CASES

The following cases demonstrate situations where investors, firms, and lenders were misled about the nature and size of investment positions. In all cases, the motivation to mislead was driven by the desire to make a large profit. The large potential gain was sought by taking large risky positions, thereby creating a severe moral hazard issue. The importance of independent risk management oversight is apparent after reading these cases.

Chase Manhattan Bank and Drysdale Securities

In 1976, Drysdale Government Securities was able to borrow $300 million in unsecured funds from Chase Manhattan. The borrowed funds far exceeded Drysdale's capital of $20 million and consequently any amount it would have normally been approved to borrow. The company used the borrowed funds to take bond positions, which eventually declined in value. Given the loss in market value, Drysdale was unable to repay the borrowed funds and was forced into bankruptcy. Almost all of the losses had to be absorbed by Chase Manhattan since it brokered most of Drysdale's borrowings.

Drysdale obtained these funds by exploiting a flaw in the market's system for computing the value of collateral of United States government bonds. In an effort to save time, this collateral was often valued without the consideration of accrued interest. This imprecise calculation method allowed Drysdale to take advantage of the difference between the cash value borrowed securities could be sold for, which accounted for accrued interest, and the amount of cash collateral required to be posted against the borrowed securities, which did not account for accrued interest.

Clearly, misleading reporting was used by Drysdale in order to obtain the borrowed funds. However, Chase Manhattan was partially to blame for assuming that it was simply the middleman in the transactions and the positions taken had a low level of risk. The inexperienced managers at Chase failed to realize that the contract wording with Drysdale indicated that Chase would be held responsible for any payments due. This financial disaster convinced the securities industry to develop more accurate methods for computing collateral when borrowing bonds. The situation also led Chase and other firms to seek the approval of a risk control function when issuing new funds.

Kidder Peabody

The head of the government bond trading desk at Kidder Peabody, Joseph Jett, misreported a series of trades between 1992 and 1994, which allowed him to report substantial artificial profits. After these errors were detected, $350 million in falsely reported gains had to be reversed. The series of events did not result in actual losses for the firm since the profits were fake; however, the trades triggered a loss of confidence in the management of Kidder Peabody, which was owned by General Electric (GE). GE ended up selling Kidder to Paine Webber, which ultimately dismantled the troubled company.

Jett was able to report false profits since the computer system used to report government bond trading activity did not account for a forward contract's present value. This enabled Jett to earn an instant profit when purchasing a bond for cash and delivering the forward contract. The system failed to realize that this profit would disappear once financing costs for the cash bond were taken into account.

Increasing the size of the forward contracts, as well as the length of the delivery period, enabled Jett to further exploit the computer's accounting error. Eventually, Jett's profits came under fire after Kidder realized that no individual trading strategy could produce the substantial profits that were being reported. This misleading reporting case demonstrates the importance of investigating large profits from unknown trading strategies.

Barings

Nick Leeson, a British Barings junior trader in Singapore, took speculative derivative positions in an effort to recoup prior trading losses that he was able to hide fraudulently. The losses went undetected due to inadequate control systems.

In 1994, Leeson lost $296 million through his trading activities, but reported a profit of $46 million to management. His trading supposedly involved two main strategies—selling straddles on the Nikkei 225 and arbitraging price differences on Nikkei 225 futures contracts that were trading on different exchanges. A short straddle strategy involves selling calls and puts. It is profitable when the underlying index remains relatively unchanged over the life of the straddle, in which case the calls and puts expire worthless, leaving the option writer with the option premiums. The Nikkei 225 futures arbitrage involves taking a long futures position on one exchange where the price is relatively low and hedging with an offsetting short position on another exchange where the price is relatively higher.

Leeson had previously incurred huge trading losses that would have cost him his job if they were revealed. In an effort to recover those losses, he abandoned the hedged posture in the long-short futures arbitrage strategy and initiated a speculative long-long futures position on both exchanges in hope of profiting from an increase in the Nikkei 225. This move exposed the firm to enormous market risk and event risk, which stems from unexpected major events that, while not directly related to markets, can affect markets.

On January 17, 1995, an earthquake hit Japan. The Nikkei plunged, creating huge losses on both the short straddle and the double-long futures position. The resulting margin calls were satisfied for a time because in 1994, Leeson had requested and received without question $354 million from the London office because they believed his strategy was riskless. This lack of oversight contributed to Barings' failure as the Nikkei continued to drop. Between 1993 and 1995, Leeson's actions resulted in losses of approximately $1.25 billion and forced Barings into bankruptcy.

In addition to being Barings' floor manager on the Singapore International Monetary Exchange (SIMEX) trading floor, Leeson was in charge of settlement operations. This position allowed him to influence back-office employees to hide his trading losses from the London office. He was able to hide speculative positions by reporting these positions for fictitious customers. He used an old error account to book losing trades for these fictitious customers and used his back-office influence to prevent that trading activity from being reported to the main office in London.

To book profits that would be reported to London, Leeson initiated cross trades on the SIMEX in which the same firm buys and sells a security at the current market price. Again using his back-office influence, he directed settlement employees to modify the execution price, making one side of the trade profitable and the other unprofitable. The profitable trade was booked to the standard trading accounts, which were reported to management, while the unprofitable trade was booked to the old error account that escaped reporting to senior management. By incorrectly booking these losses, Leeson was able to report substantial profits in 1994, which allowed him to earn a $720,000 bonus.

Leeson was able to illegally book fraudulent trades because there was *little management oversight of the settlement process*. Leeson was responsible for reporting to multiple managers in a convoluted organizational structure. This situation created ambiguity concerning who was responsible for performing specific oversight functions. In addition, political power struggles and senior management's lack of understanding about Leeson's role eroded oversight and allowed trading losses to be hidden.

Officially, Leeson was subject to risk controls that limited the amount of speculative trades he was allowed to make. In practice, however, he ignored and vastly exceeded those limits. These violations went undetected because Barings lacked risk management oversight that would have monitored positions, strategies, and risk. This oversight was so poor that the London office transferred $354 million to meet margin calls without questioning Leeson. If management had a better understanding of Leeson's trading strategies, they would have recognized that his reported profits were disproportionate to the purported riskless trading.

In sum, weak management at Barings failed to establish information, reporting, and control systems. If trading and settlement responsibilities rested with different people, coordinating the trading and settlement schemes required to hide trading losses would be much more difficult. It would have created a system of checks and balances that might have prevented Leeson from taking wildly speculative positions.

Allied Irish Bank

Between 1997 and 2002, a currency trader for Allied Irish Bank (AIB), John Rusnak, hid $691 million in losses from management. Rusnak used a number of deceptive means to hide these losses including bullying back-office workers into not following-up on trade confirmations for imaginary trades. However, in 2001, the back-office supervisor realized that something was amiss when he saw that confirmations were missing for a number of trades. After this problem was corrected, the fraudulent actions were eventually identified.

Management believed that Rusnak was running a small currency arbitrage trading strategy. However, the strategy actually being implemented involved very large currency positions. Rusnak was able to hide these trading activities from management by creating fake trades to offset his real trades. The result was the appearance of a trading strategy that involved small positions. Rusnak made a point of only reporting modest gains as to not raise any red flags. For a time, he was able to cover losses by selling deep in the money options, which provided him with large option premiums. He further disguised his actions from management by entering false positions in the firm's system for calculating risk measures such as value at risk (VaR).

AIB's management was partially to blame for its inexperience in being unable to figure out Rusnak's trading activates. Suspicious trades and trading profits were ignored by management as Rusnak continually manipulated the firm's operations staff. For a time, Rusnak even forged trade confirmations after the back-office supervisor realized the incorrect actions. This case is similar to the actions that led to the bankruptcy of Barings. However, Rusnak did not have the advantage of Leeson of also running the back-office operations. Instead, Rusnak used his strong personality to bully back-office employees and took advantage of the fact that trades were being transacted in the over-the-counter market, which did not require immediate cash settlement.

Union Bank of Switzerland

During 1997, Union Bank of Switzerland's (UBS) equity derivatives business lost between $400 and $700 million. An additional loss of $700 million followed the next year, which was mostly due to its large stake in Long-Term Capital Management (LTCM). Losses at UBS forced the firm to merge with Swiss Bank Corporation (SBC).

It is unclear which trades directly influenced the losses at UBS, but it is accepted that the losses resulted due to inadequate actions on the part of the firm's risk controllers. The equity derivatives business at UBS was being run with an unusual amount of independence. The department's senior risk manager was also the head of quantitative analytics, which enabled him to not only provide input for business decisions, but also have his compensation tied to trading results.

It is suspected that the losses in 1997 were due, in some part, to the following four factors: (1) British law tax changes; (2) large Japanese bank warrants, which were inappropriately hedged against a drop in the underlying stocks; (3) incorrect valuation of long-dated options on equity baskets; and (4) inappropriate modeling of other long-dated options. The suspected losses in 1998 were largely tied to the failure of LTCM. UBS's exposure to LTCM involved a 40% direct investment in the hedge fund and a 60% exposure to written options on the fund. By taking these two positions, UBS was hoping to delta-hedge their exposure to LTCM; however, LTCM's lack of transparency made it difficult for UBS to fully understand the nature of its positions. It was believed that UBS failed to properly analyze and stress test its positions.

Société Générale

In January 2008, it was discovered that one of Société Générale's junior traders, Jérôme Kerviel, was involved in unauthorized trading activity that resulted in losses of $7.1 billion. The incident damaged the reputation of Société Générale and required the bank to raise additional funds to meet capital needs.

Between July 2005 and January 2008, Kerviel established large, unauthorized positions in futures contracts and equity securities. To hide the size and riskiness of these unauthorized positions, he created fake transactions that offset the price movements of the actual positions. Kerviel created fake transactions with forward start dates and then used his knowledge of control personnel confirmation timing to cancel these trades right before any confirmations took place. Given the need to continuously replace fake trades with new ones, Kerviel ultimately created close to 1,000 fictitious trades before the fraud was finally discovered.

A number of reasons were cited that explained how Kerviel's unauthorized trading activity went undetected, including the incorrect handling of trade cancellations, the lack of proper supervision, and the inability of the bank's trading system to consider gross positions.

Regarding trade cancellations, the bank's system was not equipped to review trading information that was entered and later canceled. In addition, the system was not set up to flag any unusual levels of trade cancellations. Regarding the lack of supervision, oversight of Kerviel's trading activity was weak, especially after his manager resigned in early 2007. Under the new manager, Kerviel's unauthorized trading activity increased significantly. Regarding the size of Kerviel's positions, the bank's system was only set up to evaluate net positions, instead of both net and gross positions. Thus, the abnormally large size of his trading positions went undetected. Had the system properly monitored gross positions, it is likely that the large positions would have issued a warning sign given the level of riskiness associated with those notional amounts. Also, the large amount of trading commissions should have raised a red flag to management.

Additional reasons that contributed to the unauthorized positions going undetected included the inaction of Kerviel's trading assistant to report fraudulent activity, the violation of the bank's vacation policy, the weak reporting system for collateral and cash accounts, and the lack of investigation into unexpected reported trading gains.

Kerviel's trading assistant had immediate access to Kerviel's trading activities. Because the fictitious trades and the manipulation of the bank's trading system went unreported, it was believed that the trading assistant was acting in collusion with Kerviel. Regarding the bank's vacation policy, the rule that forced traders to take two weeks of vacation in a row was ignored. Had this policy been enforced, another trader would have been responsible for Kerviel's positions, and likely would have uncovered the fraudulent activity of rolling fake transactions forward. Regarding collateral and cash reports, the fake transactions did not warrant any collateral or cash movements, so nothing balanced the collateral and cash needs of the actual trades that were being offset. If Société Générale's collateral and cash reports had been more robust, it would have detected unauthorized movements in the levels of these accounts for each individual trader. Regarding reported trading gains, Kerviel inflated trading gains above levels that could be reasonably accounted for given his actual authorized trades. This action should have prompted management to investigate the source of the reported trading gains.

Ultimately, the unauthorized trading positions were discovered by chance after one of Kerviel's fake trades was detected by control personnel during a routine monitoring of positions. Kerviel's inability to explain the fictitious transaction led to a rigorous investigation, revealing the depth of his fraudulent activities.

The lessons from this control failure are similar to lessons from the other case studies of Kidder Peabody, Barings, and Allied Irish Bank. Given the common events among these cases, the importance of tighter operational controls that lead to better detection of fictitious trading activities cannot be overstated. Lessons to be learned specific to this case include the following:

- Traders who perform a large amount of trade cancellations should be flagged, and, as a result, have a sample of their cancellations reviewed by validating details with trading counterparties to ensure cancellations are associated with real trades.
- Tighter controls should be applied to situations that involve a new or temporary manager.
- Banks must check for abnormally high gross-to-net-position ratios. High ratios suggest a greater probability of unauthorized trading activities and/or basis risk measurement issues.
- Control personnel should not assume the independence of a trading assistant's actions. Trading assistants often work under extreme pressure, and, thus, are susceptible to bullying tactics given that job performance depends on them following direction from traders.
- Mandatory vacation rules should be enforced.
- Requirements for collateral and cash reports must be monitored for individual traders.
- Profit and loss activity that is outside reasonable expectations must be investigated by control personnel and management. Reported losses or gains can be compared to previous periods, forecasted values, or peer performance.

Daiwa

A Treasury bond trader, Toshihide Iguchi, covered up $1.1 billion in losses over an 11-year time span from 1984 to 1995. Iguchi was able to not only hide these losses, but also forge customer trading slips, which actually made his actions appear profitable to Daiwa Bank's management. This misleading reporting went undetected due to Iguchi's dual role as the head of both trading and the back-office support function. When senior executives finally learned of the fraud, they failed to promptly report it to the authorities. As a result, Daiwa lost its trading license in the United States.

Sumitomo

Yasuo Hamanaka, the lead copper trader for Sumitomo, attempted to corner the copper market in a classic market manipulation strategy. Because the copper market was relatively small, Hamanaka had the potential to control and corner it.

He essentially established a dominant long position in futures contracts and simultaneously purchased large quantities of physical copper. As the futures contracts approached delivery, the party with the short position would find little physical copper available for delivery and would be forced to either pay a large premium for physical copper or unwind its short position by taking an offsetting long futures position. Either way, the price of copper and/or copper futures prices would rise and create handsome profits for Hamanaka and Sumitomo.

The risk, of course, was that severe losses would be unavoidable if copper prices fell. Subjecting the firm to enormous market risk to help finance his long copper positions, Hamanaka sold put options, which exposed the trading strategy to the risk of falling copper prices even more.

Hamanaka's unusually low degree of supervision and broad powers allowed him to implement this fraudulent trading strategy without detection, until the Commodity Futures Trading Commission (CFTC) began an investigation of market manipulation in December of 1995. The CFTC's interest was piqued by the possibility that Sumitomo had purposely influenced the price of copper with positions that were unrelated to legitimate commercial needs, a critical element in the determination of market manipulation.

In May of 1996, Hamanaka was reassigned to another position, sparking suspicion among other copper traders who began to sell their copper holdings in anticipation of Sumitomo doing the same. A continuation of plummeting copper prices resulted in a $2.6 billion trading loss and a $150 million fine from the CFTC. Hamanaka was fired, prosecuted, and jailed. The size of Sumitomo's copper positions in relation to the size of the market exacerbated the drop in copper prices.

Sumitomo's lack of supervision on Hamanaka created a high degree of operational risk, which could have been reduced with proper internal controls. For example, because Hamanaka had almost total autonomy, he was able to give power of attorney to brokerage firms to execute highly leveraged transactions in a scheme to help finance his accumulation of copper. In addition, the lack of supervision allowed him to keep two sets of trading books, one of which reported large profits. The other set recorded huge losses and was secret, which allowed the illegal activities to go undetected.

Large transactions should have required multiple approvals by senior management, who would have an understanding of the trading strategy. In Sumitomo's case, however, no approvals were necessary, and senior management was unequipped to understand the complex transactions.

Askin Capital Management and Granite Capital

David Askin managed both the Askin Capital Management and Granite Capital hedge funds, which invested in mortgage securities. He misled investors by valuing positions with incorrect values instead of dealer quotes. Askin reported these incorrect values to potential clients in order to generate interest in his funds. Both funds went bankrupt in 1994, suffering losses of $600 million.

Merrill Lynch

In 1987, Merrill Lynch reported losses of $350 million from its trading in mortgage securities. The losses resulted from a mistake in the firm's calculation of duration. The firm was using a 13-year duration calculation for 30-year mortgages, which is generally correct when considering all interest and principal payments. However, since Merrill Lynch was selling the interest-only portion of the mortgage securities, the correct duration was actually more in-line with the duration of the principal-only portion, which was 30 years.

National Westminster Bank

National Westminster Bank's (NatWest) traders used incorrect volatility inputs for interest rate caps and swaptions between 1994 and 1997. It was reported that traders were only using a sample of market volatility estimates due to the illiquid nature of these investments. The loss from this incorrect reporting was close to $140 million. NatWest was forced to sell the Royal Bank of Scotland due to investor's loss of confidence in management's oversight.

LARGE MARKET MOVEMENT CASES

The following two cases on Metallgesellschaft and Long-Term Capital Management illustrate financial disasters related to large unexpected market movements. Unlike the previously discussed cases, misleading positions were not the cause of the substantial losses. These two cases share many common financial themes, including an extreme lack of liquidity.

Metallgesellschaft

In 1991, Metallgesellschaft Refining and Marketing (MGRM), an American subsidiary of Metallgesellschaft (MG), an international trading, engineering, and chemicals conglomerate, implemented a marketing strategy designed to insulate customers from price volatility in the petroleum markets for a fee.

MGRM offered customers contracts to buy fixed amounts of heating oil and gasoline at a fixed price over a 5- or 10-year period. The fixed price was set at a $3 to $5 per barrel premium over the average futures price of contracts expiring over the next 12 months. Customers were given the option to exit the contract if the spot price rose above the fixed price in the contract, in which case MGRM would pay the customer half of the difference between the futures price and contract price. A customer might exercise this option if she did not need the product or if she were experiencing financial difficulties. In later contracts, the customer could receive the entire difference in exchange for a higher fixed contract price.

The customer contracts effectively gave MGRM a short position in *long-term forward contracts*. MGRM hedged this exposure with long positions in *near-term futures* using a **stack-and-roll hedging strategy**. In this strategy, the firm buys a bundle of futures contracts with the same expiry date, known as a *stack*. Just prior to delivery, the firm liquidates the stack and buys another stack of contracts with longer expirations, known as a *roll*. The level of uncertainty in the cost of this strategy should have prompted MGRM to use a valuation reserve since they were currently basing roll costs on historical data rather than potential future costs.

MGRM used short-term futures to hedge because alternatives in the forward market were unavailable and long-term futures contracts were highly illiquid. As it was, MGRM's open interest in unleaded gasoline contracts was 55 million barrels in the fall of 1993, compared to average trading volume of 15 to 30 million barrels per day. In December of 1993, MGRM cashed out its positions and reported losses of approximately $1.5 billion.

Although some market observers cite the maturity mismatch between MGRM's short position in long-term fixed-rate contracts with customers and its long position in near-term futures contracts, many economists believe this hedging strategy is fundamentally sound. Over the life of a properly constructed hedge, the cash flows from the forward and futures contracts would balance out, provided the hedging firm could withstand interim cash flow requirements from marked to market losses, margin calls, credit risks, and liquidity risks associated with adverse market movements. The fundamental issue for MGRM was a cash flow problem that constrained the company's ability to ride out the hedge. This cash flow problem had several causes and severe consequences, which are discussed next.

Gains and losses on forward contracts are realized at the agreement's expiration, whereas futures contracts are marked to market such that the gains and losses are realized on a daily basis. In MGRM's case, gains and losses on its customer contracts were realized if and when the customers took delivery, which would occur over a 5- to 10-year period.

During 1993, oil prices dropped from a high of about $21 per barrel to about $14 per barrel, resulting in losses of $900 million on MGRM's long positions, which were realized immediately as the futures contracts were marked to market. The offsetting gains on their customer contracts, however, would not be realized for years to come, which created potential short-term cash outflows, and resulted in **funding liquidity risk**. Declining oil prices also created margin calls that exacerbated the cash flow problem. Due to these losses, MG ordered MGRM to close out of its customer contracts. This forced the firm to unwind its positions at very unfavorable terms.

According to German accounting rules, MGRM was required to report losses associated with its futures hedges, but was not permitted to show associated gains from its customer contracts, which the futures were meant to hedge. The magnitude of the losses caused its credit rating to drop, increasing its perceived credit risk and restricting the company's access to credit. The losses also created a crisis of confidence with its counterparties, which began to suspect the firm was speculating rather than hedging and, therefore, demanded collateral to secure contract performance. These same concerns induced the New York Mercantile Exchange to increase the firm's margin requirements. It is interesting to note that these consequences, which aggravated an already mounting cash flow problem, did not stem from a fundamental flaw in MGRM's hedging program. They occurred due to overly conservative financial reporting requirements that failed to recognize the relationship between hedging losses and offsetting gains on the underlying positions that motivated the hedge in the first place.

The cash outflows might have been tolerable and possibly balanced out by cash inflows over the life of the hedge were it not for the sheer size of MGRM's position, which would have taken ten days to liquidate. To liquidate without affecting market prices would have taken from 20 to 55 days. As a result, the company lacked liquidity to unwind its positions, if necessary, without significant market impact, and was therefore subject to **trading liquidity risk**. To make matters worse, MGRM was carrying a heavy debt load and had little equity to withstand losses and cash flow problems on positions of this size.

Long-Term Capital Management

Long-Term Capital Management (LTCM), a hedge fund founded in early 1994, generated stellar returns in its first few years of operation: 43% in 1995 and 41% in 1996. The partners worked together at Salomon Brothers (now Citigroup) and, given their success, decided to start their own fund and proceeded to seek capital from investors. Funding was provided to LTCM despite the secretive nature of its positions. In addition, investors were locked into investments for long periods of time in order to prevent liquidation issues since the fund was focused on long-term investment strategies. In the later years of operations, the partners at LTCM invested a large portion of their net worth in the fund since they believed so strongly in the success of their trading strategies.

With positions in equity, fixed income, and derivatives markets all around the globe, LTCM grew enormously. At the beginning of 1998, it had $125 billion of assets on $4.7 billion of equity capital, yielding leverage of 28 to 1. Although this **balance sheet leverage** was in line with other large investment banks, it underestimated the true leverage by overlooking the **economic leverage** in LTCM's positions. For example, LTCM's positions represented notional principal in excess of $1 trillion. The astronomical use of leverage was possible because financial institutions often waived initial margin requirements based on the reputation of the principals, freeing up capital to take on more leverage.

Most of LTCM's investment strategies could be classified as relative value, credit spreads, and equity volatility. Their relative value strategies involved arbitraging price differences among similar securities and profiting when the prices converged. One benefit of this convergence strategy is that being long and short similar securities hedges risk exposure and reduces volatility.

LTCM believed that, although yield differences between risky and riskless fixed-income instruments varied over time, the risk premium (or credit spread) tended to revert to average historical levels. Noticing that credit spreads were historically high, they entered into mortgage spreads and international high-yield bond spreads intending to profit when the spreads shrank to more typical historical levels. Similarly, their equity volatility strategy assumed that volatility on equity options tended to revert to long-term average levels. When volatility implied by equity options was abnormally high, LTCM "sold volatility" until it regressed to normal levels.

In August of 1998, Russia unexpectedly defaulted on its debt, sending Russian interest rates soaring to 200% and crushing the value of the ruble. This economic shock triggered investor concern about already faltering economies in the Pacific rim, causing the yields on developing nations' debt to increase and a flight to the quality of government bonds in industrialized countries. Yields on corporate debt—both high and low quality—also increased sharply. In other words, the flight to quality increased, rather than decreased, credit spreads, causing huge losses for LTCM. Shortly thereafter, Brazil also devalued its currency, thereby further increasing interest rates and risk premiums. The general increase in volatility also generated losses in LTCM's equity volatility strategies.

Although prices in relative value arbitrage strategies sometimes diverge and create temporary losses before they ultimately converge, the large increase in yield spread caused huge losses and severe cash flow problems caused by realizing marked to market losses and meeting margin calls. The effect of the losses and the cash flow crisis were compounded by the firm's hyper leverage. LTCM lost 44% of its capital in just one month. The firm's lack of equity capital created a cash flow crisis and made it necessary to liquidate positions to meet margin calls.

If LTCM had sufficient equity to withstand the cash flow crisis created by the sharp divergence of asset prices, it might have ultimately been able to realize the benefits of convergence. Instead, LTCM risked the possibility of insolvency before convergence could occur. Notice the similarity to the funding liquidity risk in the Metallgesellschaft case.

One of the fundamental risks faced by LTCM was model risk, the risk that valuation or trading models are flawed. Their models assumed that historical relationships were useful predictors of future relationships, which is often true in the absence of economic shocks. However, external shocks often cause correlations that are historically low to increase sharply. When Russia defaulted on its debt, credit spreads, risk premiums, liquidity premiums, and volatility around the world increased. LTCM partly adjusted for this possibility by using correlations that were greater than historical correlations in their stress tests. However, these adjustments inadequately captured the spike in correlations caused by the cascading effect of economic shocks.

The models also assumed that low-frequency/high-severity events were uncorrelated over time. Rather than occurring highly infrequently and independently over time, one economic shock triggered another so that extremely low probability events were occurring several times per week. As a result, traditional VaR models underestimated risk in the tails of the distribution.

LTCM was diversified across the globe, across different asset classes, and across different trading strategies. Fundamentally, however, all of its trading strategies were based on the notion that risk premiums and market volatility would ultimately decline. Since the success of all its trading strategies hinged on a single economic prediction, LTCM was far less diversified than a cursory examination would suggest and was, therefore, subject to market risk.

LTCM's extreme leverage enabled it to assume extremely large, high-profile positions that attracted the attention of imitators who initiated similar or identical trades, thereby adding to the size of LTCM's positions in some sense. When it became necessary to liquidate positions, the firm found itself in the position of being a market maker, rather than a price taker as traditional valuation models assume. In addition to suffering the price impact of liquidating its own enormous positions, LTCM found itself competing with imitators who were also liquidating their positions. Market prices largely depended on expectations about LTCM's actions.

Falling prices resulting from LTCM's forced liquidation created more marked to market losses and margin calls, which forced more liquidations that resulted in a self-reinforcing cycle. LTCM considered the possibility of market impact to some extent in its short risk measures, but underestimated the magnitude of its influence on market prices, particularly in the event of forced liquidation. Trading liquidity risk was also present in the Metallgesellschaft case.

As a hedge fund, LTCM's reporting obligation to regulators was limited. Although the size of its positions required financial statement reporting and daily position reporting, these reports were incomplete and lacked disclosure of derivative positions and trading strategies. Ultimately, the Federal Reserve Bank of New York orchestrated a bailout in which 14 leading banks and investment houses invested \$3.65 billion for a 90% stake in LTCM.

The LTCM case demonstrated the need for several suggested improvements when implementing risky investment strategies and seeking investor funds. One suggestion is to ensure that an initial margin is provided. LTCM had to mark their positions to market, but in many cases, the initial margin was waved. Another suggestion is to incorporate potential liquidation costs into prices in the event of adverse market conditions. A third suggestion is the need for greater position disclosure. A final suggestion is better utilization of stress testing when evaluating financial risk; namely credit risk. LTCM planned for the possibility of increasing disruptions in short-term market movements. However, it failed to supplement VaR measures with stress scenarios that incorporated the possibility that competitors were holding similar positions that might be liquidated at the same time in the event of extreme market movements.

CUSTOMER CONDUCT CASES

These cases describe actions that led to significant decreases in firm reputation among its customers (i.e., reputational risk). The actions relate to misleading investors on the risk of certain investments. Failure to perform the necessary due diligence subjected customers to huge losses which were, in some cases, followed by fines and settlements for the firms involved. The actions themselves, however, did not create direct losses for the firms.

Bankers Trust

Procter & Gamble (P&G) and Gibson Greetings sought the assistance of Bankers Trust (BT) to help them reduce funding costs. BT used derivative trades, which promised the two companies a high-probability, small reduction in funding costs in exchange for a low-probability, large loss. Unfortunately, the derivative trades only resulted in significant losses for both P&G and Gibson.

The derivative structures developed by BT were intentionally complex and prevented P&G and Gibson from fully understanding the trade values and risks that were involved. In addition, the structures were not comparable to other company derivative trades making it impossible to get a competitive quote. P&G and Gibson were further misled into thinking that the structures were tailored to meet their individual needs. In 1994, P&G and Gibson finally realized that they had been misled after discovering that they had suffered huge losses. As a result, the two companies sued BT.

It was common practice for BT to tape phone conversations of its traders and marketers in an effort to resolve possible verbal contract disputes. Unfortunately for BT, these tapes were used as evidence during the lawsuit since they picked up internal conversations regarding the derivative structures in question. In some of these conversations, BT's staff bragged about how badly they fooled clients with complex structures and showed how price quotes given to P&G and Gibson were manipulated.

The Bankers Trust scandal severely damaged its reputation and forced its CEO to resign. BT was eventually acquired by Deutsche Bank and ultimately dismantled. The actions at BT led to tighter controls for dealing with clients at other firms. This case demonstrated the importance of matching trades with a client's needs and providing price quotes that are independent from the front office. It also demonstrated the importance of exercising caution with any form of communication that could eventually be made public, as it could damage a firm's reputation if unethical practices are present.

JPMorgan, Citigroup, and Enron

In the wake of the Bankers Trust scandal, investment banks worked to prevent future exploitation of customers. However, at the time, banks still did not assume responsibility for protecting third parties against adverse actions taken by its borrowers. This changed once the financial shenanigans at Enron surfaced in 2001, which eventually led to the company's bankruptcy. The Enron scandal revealed the use of questionable accounting practices to disguise the size of borrowings from lenders and investors. One practice accounted for borrowed amounts as oil futures contracts.

Given that the Enron Corporation was heavily involved in the energy markets, it was not uncommon for the company to trade large amounts of oil futures contracts. However, the futures contracts that were actually used did not involve any stake in oil price movements. Enron collected cash by selling oil for future delivery, and, in turn, agreed to buy back the delivered oil at a fixed price. Thus, no oil was actually delivered, so the agreement was essentially a loan where the company paid cash at a later date to receive cash at the beginning of the agreement. The advantage for Enron was that the company did not have to account for these transactions as loans on its financial statements, which made the company look healthier to both investors and lenders.

JPMorgan Chase and Citigroup were the main counterparties in these transactions. When Enron's actions were ultimately revealed, the investment banks declared that they shared no role in determining how the transactions were accounted for on Enron's financial statements. According to JPMorgan and Citigroup, the transactions were correctly reported as loans on the bank's financial statements, and therefore, they did not trick their own investors and lenders. However, it was later revealed that the investment banks fully understood Enron's intent when entering into these loan-type transactions. As a result, JPMorgan and Citigroup agreed to pay a $286 million fine for assisting with fraud against Enron investors. In addition, future controls were established to improve the transparency of client derivative transactions for investors.

Prudential-Bache Securities

Prudential-Bache Securities misled investors regarding the risk of investments in limited partnerships. The incorrect identification of risk impacted thousands of investors and was so severe that it resulted in over $1 billion in fines and settlements.

Morgan Grenfell Asset Management

A fund manager at Morgan Grenfell Asset Management incorrectly directed investors into highly speculative equity investments. In addition, this manager found a way to bypass legal restrictions regarding the percentage of a stock that a mutual fund could hold at one time. In 1995, Morgan Grenfell was ordered to pay approximately $600 million to investors to make up for losses incurred by incorrectly investing in speculative securities.

KEY CONCEPTS

LO 6.1

Drysdale Securities was able to borrow $300 million in unsecured funds from Chase Manhattan by exploiting a flaw in the system for computing the value of collateral.

The head of the government bond trading desk at Kidder Peabody, Joseph Jett, reported substantial artificial profits. After the false profits were detected, $350 million in previously reported gains had to be reversed.

Hidden trading losses at Barings induced Nick Leeson to abandon hedging strategies in favor of speculative strategies. A lack of operational oversight and his dual roles as trader and settlement officer allowed him to conceal his activities and losses.

A currency trader for Allied Irish Bank, John Rusnak, hid $691 million in losses. Rusnak bullied back-office workers into not following-up on trade confirmations for imaginary trades.

UBS's equity derivatives business lost millions in 1997 and 1998. The losses were mostly due to incorrect modeling of long-dated options and the firm's stake in Long-Term Capital Management.

Jérôme Kerviel, a junior trader at Société Générale, participated in unauthorized trading activity and concealed this activity with fictitious offsetting transactions. The fraud resulted in $7.1 billion in losses and severely damaged the reputation of Société Générale.

Extreme leverage, a lack of diversification, and inadequate risk models put Long-Term Capital Management in a cash flow crisis when an economic shock created intolerable marked to market losses and margin calls. A forced liquidation of its huge positions drove prices down, further compounding their losses.

The financial crisis at Metallgesellschaft resulted fundamentally from cash flow timing differences associated with the positions making up its hedge. Cash flows on short forward contracts occurred over the distant future. Cash flows on long futures contracts occurred daily. In addition, the sizes of the positions were so large that it prevented the company from liquidating its positions without incurring large losses.

Bankers Trust developed derivative structures that were intentionally complex and prevented Procter & Gamble and Gibson Greetings from fully understanding the trade values and risks that were involved. In taped phone conversations, BT's staff bragged about how badly they fooled clients.

JPMorgan Chase and Citigroup were the main counterparties in Enron's derivative transactions. After the Enron scandal was revealed, these investment banks agreed to pay a $286 million fine for assisting with fraud against Enron shareholders.

CONCEPT CHECKERS

1. Which of the following was least influential in the Metallgesellschaft debacle?
   A. Fraud.
   B. Timing differences in the cash flows of its long and short positions.
   C. The size of its positions influenced market prices.
   D. Financial reporting requirements.

2. Which of the following financial disasters created a situation that resembled a classic Ponzi scheme where artificial profits are shown, but never materialize into actual profits?
   A. Drysdale Securities.
   B. Bankers Trust.
   C. Kidder Peabody.
   D. Merrill Lynch.

3. In 1997, equity derivative losses at the Union Bank of Switzerland (UBS) appeared to be related to four different factors. Of the factors shown below, which ones are unique to UBS (i.e., did not impact competitors)?

   I. British law tax changes and large Japanese bank warrants.
   II. Incorrect valuation of long-dated options on equity baskets and inappropriate modeling of other long-dated options.

   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

4. Hedging models at Long-Term Capital Management accounted for the:

   I. spike in correlations among asset class prices during times of economic crisis.
   II. dependence of catastrophic events through time during global economic shocks.

   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

5. Nick Leeson's now infamous trading strategies in 1994 and 1995 at Barings Bank focused on calculated bets on the Nikkei 225. Which of the following trading strategies did not contribute to the staggering losses that ultimately forced Barings into bankruptcy?

   I. Long-long futures arbitrage.
   II. Long straddle.

   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

CONCEPT CHECKER ANSWERS

1. **A** The fundamental problem at Metallgesellschaft was that the timing of the marked to market losses and margin calls on its futures contracts were mismatched with the cash flows on the forward contracts it was trying to hedge. The problem was compounded by the enormous size of the positions, which made liquidation costly, and by conservative financial reporting requirements that did not recognize the gains on the forward contracts. Neither fraud nor deception is central to the Metallgesellschaft case.

2. **C** The head of the government bond trading desk at Kidder Peabody, Joseph Jett, misreported a series of trades, which allowed him to report substantial artificial profits. After these errors were detected, $350 million in falsely reported gains had to be reversed. This situation of hypothetical profits in place of promised profits resembles a classic Ponzi scheme.

3. **B** Statement I resembles factors that affected UBS as well as its competitors. The bank warrant positions may have been larger than its competitors, but they were not unique to UBS. Statement II resembles factors that were unique to UBS.

4. **D** The models used by LTCM primarily relied on historical correlations to measure risk. In doing so, the firm failed to account for the spike in correlations caused by economic shocks, such as Russia defaulting on its debt. The models also did not consider that infrequent shocks might be clustered in time, one causing another. As it happened, risk premiums rose across the globe, forcing LTCM to liquidate positions because its relatively miniscule equity basis was insufficient to withstand the losses. The size of its positions aggravated negative price trends that were already set in motion.

5. **B** After incurring huge trading losses, Leeson made an effort to recover those losses by abandoning his original hedged position in a long-short futures arbitrage strategy and initiated a long-long futures position on two trading exchanges. As well, one of his other trading strategies was selling straddles on the Nikkei 225 (which would have been profitable had the underlying index remained relatively unchanged).

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

DECIPHERING THE LIQUIDITY AND CREDIT CRUNCH 2007–2008

Topic 7

EXAM FOCUS

This topic discusses the key factors the led to the housing bubble and the banking industry trends that caused the subsequent liquidity squeeze. It identifies the array of events that unfolded during the recent financial crisis and the channels through which the mortgage crisis became a financial disaster. Securitization and the methods of asset and liability maturity management employed by banks were the main causes for the liquidity crisis. For the exam, be able to describe the uses of securitized and structured products and understand how the financial crisis triggered a series of worldwide financial and economic consequences. Also, be able to distinguish between funding liquidity and market liquidity and identify their connection to loss spiral and margin spiral. Finally, be familiar with how an increase in counterparty credit risk can generate additional funding needs and possible systemic risk.

KEY FACTORS LEADING TO THE HOUSING BUBBLE

LO 7.1: Describe the key factors the led to the housing bubble.

The housing bubble, which later burst and caused a liquidity squeeze, can been seen as the product of the following two broad factors:

1. *Cheap credit.* Interest rates were low in the lead-up to the housing bubble due to a combination of factors. First, an increase in demand for U.S. securities by foreign governments experiencing trade surpluses put downward pressure on interest rates. Also, the Federal Reserve adopted a lax interest rate policy that promoted low interest rates to fend off deflation after the bursting of the internet bubble.

2. *Decline in lending standards.* In the past, banks held onto loans that they made until the loan was repaid. In the years leading up to the housing bubble, this traditional banking model was replaced by a new **originate-to-distribute model** of banking, in which loans are collected together, sliced into tranches, and then sold as securities. Since loan-originating institutions could transfer the default risk of borrowers to investors, the originating institutions had little incentive to be rigorous or diligent in their creditworthiness assessments. (There are stories of banks awarding mortgage loans upon presentation of only a driver's license.) As a result, lending standards fell substantially.

This decline in lending standards and abundance of cheap credit led banks to offer credit at low interest rates and lenient terms. This environment of cheap money and plentiful borrowing opportunities led to a flood of real estate purchases, which generated a housing boom.

BANKING INDUSTRY TRENDS AND THE LIQUIDITY SQUEEZE

LO 7.2: Explain the banking industry trends leading up to the liquidity squeeze and assess the triggers for the liquidity crisis.

The 2007–2008 U.S. mortgage crisis produced unprecedented financial turmoil—indeed, the worst since the Great Depression.

The related **liquidity squeeze** was caused by two major banking industry trends:

1. *Risk transference through asset securitization*: through the originate-to-distribute model.
2. *Asset-liability maturity mismatch*: the purchase of long-term assets through the rollover of short-term debt instruments.

Securitization

In the past, banks that originated loans held those loans until they were paid off; hence, these banks had an incentive to exercise due diligence in evaluating the creditworthiness of the borrower.

More recently, instead of retaining loans and carrying the risk of default of borrowers, banks began to transfer this risk to investors through securitization. Banks developed structured products [e.g., collateralized debt obligations (CDOs)] based on an underlying pool of mortgages, bonds, and other loans. The portfolio of underlying assets is sliced into various tranches (mainly senior, mezzanine, and equity), which offer a mix of risk and return tradeoffs. For example, the senior tranche is the least risky due to the priority claim on cash flows; therefore, it offers the lowest return. Securitization enables the originating institution to detach itself from the default risk of the underlying pool of assets and transfer it to investors, allowing these investors to select a tranche based on their specific risk and return preferences. In LO 7.5, we will dig deeper into securitization and structured products and the consequences of their use.

Asset/Liability Maturity Management

Sponsoring banks created **structured investment vehicles** (SIVs) that focused on investing in structured products. Enabled by the environment of low interest rates and high ratings, these SIVs raised money by issuing short-term commercial paper to fund purchases of long-term assets, such as mortgage-backed securities (MBSs) and other securitized products. However, due to the maturity mismatch between short-term commercial paper and long-term MBSs, the SIVs were exposed to **funding liquidity risk**. Funding liquidity risk is the risk that buyers of commercial paper [mostly money market funds (MMFs)] might stop buying commercial paper, preventing these SIVs from rolling over the short-term debt. This is exactly what happened during the financial crisis as asset prices began to fall and liquidity quickly evaporated. We will further discuss the details of this breakdown of the short-term financing mechanism in LO 7.6.

Sponsoring banks had granted a credit line, called a **liquidity backstop**, to SIVs to ensure continuity of funding liquidity. By extending credit, sponsoring banks were subject to liquidity risk, while long-term assets and their short-term financing remained an off-balance-sheet item. Banks took gigantic losses, including bankruptcies, when they were called upon to inject liquidity into the troubled SIVs.

The SIVs also used short-term repurchase agreements, or repos, for financing long-term assets, necessitating the frequent rollover of the short-term debt in the repo market. This financing mechanism of investing in long-term assets through repurchase agreements left SIVs and their sponsoring banks vulnerable to any breakdown. Later events demonstrated that, as with commercial paper, financing assets through the repo market was risky.

In summary, due to the short-term financing through commercial paper and the repo market and the liquidity commitments given to SIVs, banks left themselves vulnerable. These institutions were eventually forced to sell assets into distressed markets at low prices.

COLLATERALIZED DEBT OBLIGATIONS

LO 7.3: Explain how banks created collateralized debt obligations.

A **collateralized debt obligation** (CDO) is a "structured" product that banks can use to unburden themselves of risk.

The creation of a CDO might be thought of as a three-step process:

1. *Form a diversified portfolio.* The bank collects a number of debt assets, such as mortgages, corporate bonds, various kinds of loans, as well as other types of debt instruments such as credit card receivables.

2. *Slice the portfolio into tranches.* The cash flows from the portfolio of collected securities are sliced into a number of investable **tranches** (a French word meaning "slices"), each with different characteristics. The most junior tranche offers a high interest rate but receives cash flows only after all other tranches have been paid. (For this reason, this most junior tranche is sometimes referred to as the "equity tranche" or even "toxic waste.") Above the equity tranche are the mezzanine tranches, which receive payment before the junior tranches. The highest-rated tranche, called the "super senior" tranche (often rated AAA), is the safest tranche and the first tranche to be paid out; however, it pays investors a relatively low interest rate.

3. *Sell tranches to investors.* Different groups of investors have varying appetites for risk. The most senior tranches are sold to institutions that desire or require instruments with high credit ratings, such as pension funds. The lowest rated (equity) tranches are (in theory, at least) retained by the CDO issuer to give that bank incentive to monitor the loan. In practice, CDO issuers do not always hold onto this "toxic waste."

CREDIT DEFAULT SWAPS

LO 7.4: Explain the purposes and uses of credit default swaps.

Credit default swaps (CDSs) are insurance contracts that pay off when some reference instrument (such as a bond or a CDO tranche) defaults.

Like other insurance contracts, the buyer of a CDS pays a fixed periodic fee for protection and in return receives a payment in the event of a default.

The holder of a bond or a CDO tranche might use a CDS to provide protection against such a default. An investor who holds both a credit instrument plus CDS protection on the same instrument has a very low-risk position—provided that the CDS counterparty does not default.

In addition to individual credit default swaps, there are also tradable CDS indices, including the CDX Index in the United States and iTraxx in Europe.

GROWTH OF SECURITIZATION AND STRUCTURED PRODUCTS

LO 7.5: Describe how securitized and structured products were used by investor groups and describe the consequences of their increased use.

To develop a better appreciation of securitization and the originate-to-distribute model, we need to understand the underlying reasons for the rapid growth of securitized products.

1. Originating institutions were in a position to offer lower interest rates on mortgages because (through securitization) they could spread the risk among several investors who were willing to bear the risk.

2. Securitization offered benefits to certain institutional investors that faced regulatory prohibition against investing in, for example, less than AAA-rated securities. Securitized products can help overcome these regulatory hurdles. For example, such an institution can invest in the AAA-rated senior tranche of a structured product, even if the underlying pool is made of BBB-rated securities.

3. Securitization provides regulatory and rating arbitrage opportunities to the originating institutions. The higher ratings of securitized products can allow a bank to meet lower regulatory capital charge requirements, without actually decreasing overall risk. Loan-originating institutions created an off-balance sheet entity (i.e., SIV) and moved pools of loans to the SIVs, lowering the number (and the dollar amount) of loans on the balance sheet. This reduced the capital charge as mandated by Basel I (i.e., at least 8% of the loans on the balance sheet). The sponsoring institution granted a non-contractual credit line (also known as a "reputational" credit line) to the SIVs, ensuring a AAA rating to the securitized product. Under Basel I, there was no capital charge whatsoever on non-contractual credit lines extended to SIVs by sponsoring banks.

   Basel II attempted to correct this loophole by instituting a capital charge based on asset ratings. Still, by pooling loans into SIVs, banks were able to lower capital because (due to perceived diversification effects) rating agencies often gave a high rating to a securitized portfolio of assets. For example, combining two assets separately rated BBB might produce a theoretically low-risk securitized asset with a AAA rating if the return correlation of the BBB-rated assets was sufficiently negative. The bank may be able to hold this structured investment, as opposed to holding the two assets separately, at almost zero capital charge.

4. Structured products were given high ratings based on faulty over-optimism. Rating agencies made future projections in line with past housing data, which showed generally low delinquency and default rates. A broad decline in the real estate market had not been anticipated. It was expected that a downturn in housing prices in one region would be offset by appreciation in others because price decreases tended to be region-specific rather than nationwide. In reality, real estate prices fell across the entire country, and the quantitative models based on assumptions, scenarios, and projections using past information turned out to be substantially inaccurate. Rating agencies received higher fees for rating structured products compared to rating bonds only. This also explains, to some extent, why structured products received generously high ratings—sponsoring banks and rating agencies cooperated to ensure that senior tranches received a AAA rating. In pursuit of yield, fund managers invested in these structured products with expectations of higher returns and a low probability of downside risk.

CONSEQUENCES OF THE FINANCIAL CRISIS

LO 7.6: Describe how the financial crisis triggered a series of worldwide financial and economic consequences.

The subprime mortgage crisis, which emerged in February 2007, is considered to be the main trigger of the worldwide financial crisis.

As delinquencies and foreclosures started to rise and housing prices began to fall, the cost of credit default swaps (a financial instrument insuring the default risk on debt securities, including MBSs) increased significantly. UBS sustained huge losses related to subprime securities and decided to shut down its internal hedge fund in May 2007. Bear Stearns saw two of its hedge funds face difficulty meeting margin calls in June 2007. In July, the National Association of Home Builders announced a decline in new home sales, the largest homebuilding company in the United States experienced a loss in the same quarter, and Countrywide Financial reported a loss. The months of June and July 2007 are important in the financial history of the United States, as the subprime mortgage crisis reached its peak. Perhaps the most important development in these two months was the downgrading of subprime and other tranches of mortgage-related securitized assets by three major rating agencies.

All these events were shocking for market participants, as these developments produced a significant, negative impact on the prices of mortgage-related securities.

Commercial paper was a major vehicle for SIVs to roll over their short-term debt for the purpose of financing their investments in long-term, asset-backed securities. In the environment of shocks, uncertainty, skepticism, and difficulties in valuation of structured investments in rapidly deteriorating market conditions, cracks started appearing in the commercial paper market in July 2007. In the same month, the SIV sponsored by the small German bank IKB failed to obtain funding in the commercial paper market, and the bank was unable to inject the promised liquidity. The bank had to be bailed out through a rescue package with the participation of private and public banks. American Home Mortgage Investment Corp. declared bankruptcy in August 2007 due to its inability to roll over short-term debt. Concerned with rising demand for redemptions by investors panicked by the crumbling market conditions, French bank BNP halted redemptions for three of its funds.

Participants in the short-term credit market became reluctant to lend to each other as the short-term funding problems quickly spread beyond the commercial paper market. (The repo market, the federal funds market, and the interbank market were shaken, as well.) Banks and other borrowers found it difficult to roll over the debt at reasonable rates and terms. For example, the spread between LIBOR and U.S. Treasury bills (i.e., the TED spread) jumped to nearly 4% in September and October 2008. This spread was a reflection of the severity of the liquidity squeeze in the marketplace.

Faced with huge losses and margin calls, banks and hedge funds burdened with large investments in securitized products were forced to liquidate assets at depressed prices, further adding to their losses. In this background of increased default and liquidity risk (at least as perceived by market participants), the interbank market froze on August 9, 2007. The liquidity squeeze was not confined to the financial sector alone—as the flow of credit among banks virtually stopped, the availability of credit in the real sector became correspondingly scarce.

Funding Liquidity and Market Liquidity

LO 7.7: Distinguish between funding liquidity and market liquidity and explain how the evaporation of liquidity can lead to a financial crisis.

Funding liquidity refers to an institution's ability to immediately settle obligations when they are due. If a bank is not able to settle its obligations on time, the bank is illiquid.

Leveraged investors pledge the asset that they purchase as collateral; however, they cannot borrow 100% of the price of the asset. Rather, the investor must provide equity capital to finance the margin in an amount equal to the difference between the purchase price and the collateral value of the asset. Required margin will fluctuate daily with market fluctuations in the asset price.

Traders usually do not retain excess cash, rather they invest whatever funds they have. When adverse market conditions result in a decrease in the collateral value of an asset, traders may face a stressful situation where they must increase their equity capital contribution to meet the increased margin requirements.

Funding liquidity risk refers to the possibility that an institution will not be able to settle its obligations when they are due. In liquid markets, investors can borrow money with ease. These same investors may experience funding liquidity risk when market conditions deteriorate. Traders may be forced to sell an asset at a substantially lower price in deteriorating market conditions to meet margin requirements. Three forms of funding liquidity risk are as follows:

- **Margin/haircut funding risk:** A risk that arises when a decline in the collateral value of an asset results in an increase in margin requirement, requiring additional equity capital.
- **Rollover risk:** The risk that investors may not be able to roll over short-term debt to finance the purchase of an asset. The breakdown of short-term commercial paper and repo markets for financing long-term investments was a trigger that transformed the mortgage crisis into a global financial crisis. Short-term debt markets dried up, and SIVs and hedge funds, heavily invested in MBSs and other asset-backed securities, were unable to continue to use these securities as collateral for rolling over debt.
- **Redemption risk:** The risk that depositors will withdraw funds from banks, or that investors will redeem their shares (e.g., from mutual funds). A decline in a source of funding has the same effect as an increase in margin requirements.

Market liquidity refers to the ease or difficulty of selling an asset to raise money. Market liquidity is high if it is relatively easy to find a counterparty to buy an asset at the going price (i.e., without lowering the price to attract a buyer). Market liquidity can be expressed in the following three forms:

- **Bid-ask spread** can be thought of as the loss that would be sustained by a trader who sells an asset and then immediately buys it back. The higher the spread, the lower the market liquidity, and vice versa.
- **Market depth** refers to the number of units of an asset a trader can buy or sell at the current market quote (bid and ask prices). The greater the market depth, the higher the market liquidity.
- **Market resiliency** describes the length of time it will take an asset to regain its price after the price has fallen temporarily.

Funding Liquidity vs. Market Liquidity

Consider two ways of raising funds: (1) selling an asset, or (2) using an asset as collateral to borrow money against it. Raising money by selling an asset is associated with market liquidity. Market liquidity is low if it is difficult to sell the asset. Funding liquidity is associated with the use of an asset as collateral to borrow money against it. As discussed earlier, funding liquidity risk is high if margins or redemptions increase, or if rolling over short-term debt becomes difficult.

Interaction of funding liquidity and market liquidity can trigger a significant and sudden decline in, or even disappearance of, liquidity, transforming a relatively small shock into a financial disaster. The recent global financial crisis is an example of the interaction of funding and market liquidity risks.

Loss Spiral and Margin Spiral

To maintain a particular margin (or leverage ratio) in the face of a market decline, an investor may need to sell a portion of assets to ensure that the overall value of the position aligns with the current smaller amount of equity capital and the lower borrowing capacity. These kinds of forced sales put additional downward pressure on asset prices, further eroding equity capital and necessitating more forced sales. This situation becomes a **loss spiral** when the decline leads to a cycle of further price decreases and further forced sales.

A loss spiral is a function of market liquidity. An asset with low market liquidity will sustain a greater loss in a forced sale compared to an asset with higher market liquidity. This cycle of forced sales does not necessarily self-correct because potential buyers may be reluctant to enter into the market or may be facing a similar situation. In other cases, traders may engage in what is called **predatory trading**—creating a situation in which the seller, already distressed from reducing his position, is forced to sell at an unnaturally low price.

A **margin spiral** refers to the forced sale of an asset as a result of an increase in required margin, or, equivalently speaking, a decline in the permitted leverage ratio. Investors may be required to increase their contributed equity capital in conditions of deteriorating market conditions and tightening of lending. To satisfy the increased margin requirements, an investor may have to sell even more assets than under a loss spiral event in which margins and leverage ratios are held constant.

To illustrate a loss spiral and a margin spiral, assume that an investor has an original investment position of $100, with $10 of equity capital and $90 of borrowing (i.e., leverage ratio is 10). Suppose that the investment assets experience a 5% decline in *asset value*, from $100 to $95. In other words, the investor lost $5 in capital and only has $5 remaining. To maintain the leverage ratio of 10, the investor would be forced to sell assets worth $45 to bring the value of the position down to $50. Now assume the same situation except that the investor experiences a decline in the *leverage ratio* from 10 to 5. The $5 of equity would support a position value of only $25, forcing the investor to sell assets worth $95 – $25 = $70.

Thus, in an environment of declining prices and general tightening of lending, the necessity to deleverage can produce an ongoing cycle of forced sales, erosion of equity capital, and continued downward pressure on prices.

In summary, with a loss spiral, a trader initiates a sale to maintain the leverage ratio; whereas with a margin spiral, a trader sells an asset to fulfill the requirements of a decline in the leverage ratio (as a result of rising margins). Consequently, all else equal, a margin spiral situation results in a lower overall position value and lower borrowing amounts versus a loss spiral situation.

NETWORK RISK

LO 7.8: Analyze how an increase in counterparty credit risk can generate additional funding needs and possible systemic risk.

Network risk arises as a result of an increase in counterparty credit risk, particularly in an environment of market stress. This increased risk causes a web of contracting parties to seek additional protection and liquidity, for example, by purchasing credit default swaps or by demanding increased collateral. In this way, network risk can produce a potential systemic effect. Network risk is exacerbated by the absence of a **clearinghouse**, which is a central regulatory authority that can manage multilateral netting among multiple contracting parties that possess less than full information on one another.

Today's financial system consists of a network of obligations distributed among numerous institutions. Not all financial products are traded in formal markets; for example, structured and complex financial products such as CDOs and swaps are traded over the counter.

A clearinghouse serves as a hub of information about the network of contracting parties and their positions and obligations. In this capacity, a clearinghouse can facilitate multilateral netting arrangements, which eliminates counterparty credit risk, and, thus, the need for additional funding protection.

An example of network risk comes from the days immediately after the bankruptcy of Lehman Brothers. Major investment banking firms had entered into multiple agreements with one another, involving various financial products. In the absence of a centralized clearinghouse, full information, and multilateral risk netting arrangements, each investment bank was unable to assess the creditworthiness of the other banks. As a result, they all started purchasing CDSs on the obligations of one another, causing a nearly 100% increase in the price of these instruments. The price of the CDS for AIG, for example, increased more than 100% in a mere two days. These activities contributed to the overall deteriorating market conditions and skepticism, intensifying the spread of systemic risk.

KEY CONCEPTS

LO 7.1

The two main factors that led to the housing bubble were:

1. Cheap credit: Large capital inflows from abroad plus the Fed's lax interest rate policy lead to a low interest rate environment in the United States, making mortgages less expensive for borrowers.

2. Decline in lending standards: The originate-to-distribute model allowed banks to offload risk to investors, which led to falling lending standards because banks had less incentive to exercise care when approving and monitoring loans.

LO 7.2

The originate-to-distribute model and asset-liability maturity mismatches were two key banking industry trends that led to the mortgage crisis and resulting liquidity squeeze.

LO 7.3

Banks create collateralized debt obligations (CDOs) to unburden themselves of risk. First, the bank will bundle a number of debt instruments, such as bonds and loans. Then, this portfolio is sliced into various tranches. Finally, the different tranches are sold to investors with varying appetites for risk.

The super senior tranche, which is the safest tranche and first to be paid out (but pays the lowest interest rate), is sold to investors that have low risk tolerance. The most junior or equity tranche is typically (but not always) retained by the CDO issuer to give the bank incentive to monitor the loans carefully. The mezzanine tranche is in-between the senior and equity tranches.

LO 7.4

Credit default swaps (CDSs) are essentially insurance contracts that pay off in the event of the default of a bond or tranche. The protection buyer pays the protection seller a set fee at fixed intervals and in exchange receives protection in the form of a payment if the debt instrument experiences a credit default.

LO 7.5

The originate-to-distribute model refers to the process through which banks create securities based on an underlying pool of mortgages, bonds, or other loans and then sell the securities to investors. By originating and selling the securitized assets, the banks transfer the default risk of borrowers to the investors.

Banks, via structured investment vehicles (SIVs), used commercial paper and repurchase agreements (repos) to roll over short-term financing for investing in long-term assets. The banks' mismatches in asset-liability maturities exposed the banks to funding liquidity risk.

LO 7.6

The financial crisis that stemmed from rising mortgage delinquencies and falling housing prices led to a worldwide liquidity crisis because institutions had (1) taken on too much leverage, (2) generated large maturity mismatches between assets and liabilities, and (3) become too interconnected.

LO 7.7

Funding liquidity refers to the ability of an institution to settle its obligations when they are due. Market liquidity refers to the ease with which an asset can be sold without having to lower the price to attract a buyer.

Loss spiral refers to the forced sale of an asset by a leveraged investor to maintain margin or leverage ratio requirements. A margin spiral refers to the forced sale of an asset as a result of an increase in margins or, equivalently speaking, a decline in the leverage ratio.

LO 7.8

Network risk arises as a result of an increase in counterparty credit risk, which forces contracting parties to seek additional protection and liquidity enhancement. In the absence of a clearinghouse that could facilitate multilateral netting arrangements, an increase in counterparty credit risk can produce systemic effects, as evidenced by the recent global financial crisis.

CONCEPT CHECKERS

1. A factor that did not significantly contribute to the housing bubble was:
   A. lax interest rate policy.
   B. the originate-to-distribute banking model.
   C. large capital outflows to foreign countries.
   D. financial securitization.

2. Regarding banking industry trends that lead to the liquidity crisis, which of the following statements is correct?
   A. Asset-liability maturity mismatch refers to the purchase of short-term assets through short-term financing.
   B. Banks use commercial paper and long-term bonds to finance the purchase of long-term assets.
   C. Management of asset-liability maturity mismatch refers to risk transference through asset securitization.
   D. The subprime mortgage crisis reached its peak in June and July of 2007.

3. Which of the following statements regarding securitization is least accurate?
   A. Securitization enables an originating institution to transfer the default risk of the underlying pool of assets.
   B. Securitization enabled the originate-to-distribute banking model.
   C. Securitization may allow institutional investors to indirectly hold assets that they are prevented from holding directly.
   D. Securitization gives originating banks greater incentive to approve and monitor loans carefully.

4. Regarding funding liquidity and market liquidity, which of the following statements is correct?
   A. The use of a purchased asset as collateral to borrow money against is referred to as market liquidity.
   B. A decline in a source of funding has the same effect as a decrease in margin.
   C. A loss spiral is a negative function of market liquidity.
   D. In a margin spiral, a trader initiates a sale to maintain the leverage ratio (i.e., constant margins).

5. Which of the following statements related to counterparty credit risk is least accurate?
   A. Network risk arises as a result of an increase in counterparty credit risk, causing a web of contracting parties to seek additional protection and liquidity.
   B. A clearinghouse can facilitate multilateral netting arrangements, which decreases network risk.
   C. Financial systems consist of a network of obligations distributed among numerous institutions.
   D. Financial products, such as collateralized debt obligations (CDOs) and interest rate swaps, are traded on organized trading exchanges.

CONCEPT CHECKER ANSWERS

1. **C** Significant *inflows* of capital from abroad (primarily from Asian countries) contributed to low interest rates in the U.S. economy; the resulting cheap credit for borrowers helped to inflate the housing bubble. Low interest rates, the originate-to-distribute banking model, and financial securitization all contributed to the U.S. housing bubble.

2. **D** The subprime mortgage crisis reached its peak in June and July of 2007. Asset-liability maturity mismatch refers to the purchase of long-term assets through short-term financing. Banks used commercial paper and repurchase agreements to finance the purchase of long-term assets. Securitization (and not management of asset-liability maturity mismatch) refers to risk transference through asset securitization.

3. **D** After securitization, banks have *less* incentive to be careful in making loans because much of the risk will be borne by other institutions. Instead of retaining loans and carrying the risk of default of borrowers, banks can transfer this risk to investors through securitization. Securitization enabled the originate–to-distribute model of banking (in which loans are securitized and resold) to replace the traditional model of banking (where banks held loans until repaid). Securitization can allow institutional investors to indirectly hold assets that regulations have prohibited the institution from holding directly.

4. **C** A loss spiral is a *negative* function of market liquidity. The first statement refers to *funding* liquidity and not *market* liquidity. A decline in funding has the same effect as an *increase* in required margin. Statement D refers to *loss* spiral and not *margin* spiral.

5. **D** CDOs and swaps are traded in the over-the-counter market, not on organized trading exchanges. A clearinghouse can facilitate multilateral netting arrangements, eliminating counterparty credit risk, and thus lowering network risk.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

GETTING UP TO SPEED ON THE FINANCIAL CRISIS: A ONE-WEEKEND-READER'S GUIDE

Topic 8

EXAM FOCUS

The financial crisis of 2007–2009 was caused by a complicated mix of relaxed lending practices, easy access to credit, inflated housing prices, and an interconnected banking and global financial system. For the exam, understand the background leading up to the financial crisis and the main factors that caused the crisis. Also, be familiar with the role that the Lehman Brothers bankruptcy played in the crisis and the two main panic periods. Finally, be able to assess the government actions in response to the crisis and their efficacy, and describe the global effects of the crisis.

FINANCIAL CRISIS OVERVIEW

LO 8.1: Distinguish between triggers and vulnerabilities that led to the financial crisis and their contributions to the crisis.

LO 8.2: Describe the main vulnerabilities of short-term debt especially repo agreements and commercial paper.

In this section, we provide an overview of the market participants involved in the financial crisis of 2007–2009 and describe the different types of complex financial products that were used during that period. We also provide a snapshot of the financial markets at the time of the crisis.

Key Terms Related to the Financial Crisis

Asset-backed commercial paper (ABCP). Commercial paper is created when nonfinancial firms with high credit ratings raise capital by issuing short-term debt. ABCP is the bundling of longer-term debt from mortgages, credit card receivables, and other loans. When ABCP reaches its maturity date, it is rolled over and bundled into new ABCP.

Bank run or "run". A bank run occurs when depositors withdraw cash from a bank thinking the bank is about to fail. A run can also be used as a generic term describing the withdrawal of cash by investors from any type of financial intermediary [e.g., a pension plan (depositor) withdrawing cash from a money market mutual fund (MMF)]. This example would be a run on the MMF.

Shadow bank. A shadow bank is a financial institution other than a regulated depository institution. Examples of regulated depository institutions are commercial banks, thrifts, and credit unions. Examples of shadow banks are private equity funds, investment banks, hedge funds, mortgage lenders, and insurance companies.

Repurchase agreements (repos). Repos involve an institutional investor making a short-term deposit of cash with a shadow bank that in turn pays the investor interest on the cash (called the **repo rate**). The shadow bank also gives the investor some type of collateral that the investor could sell in the event that the shadow bank does not return the investor's cash.

Haircut. A haircut is the amount of collateral in a repo agreement in relation to a deposit. For example, if an institutional investor deposits $90 million with a shadow bank and the investor receives collateral worth $100 million, the haircut is 10%.

Financial Market Participants and Market Conditions

The main financial market participants in the financial crisis starting in 2007 were institutional investors, such as money market mutual funds, nonfinancial firms, municipalities and state governments, and other large entities investing large amounts of cash with shadow banks. The amount of cash held by institutional investors was larger than could be insured through a regular depository bank. In addition, at that time, U.S. Treasuries were in short supply due to large holdings from foreign investors. Thus, the shadow banks acted as financial intermediaries, providing institutional investors with a way to turn their cash into an investment by issuing repos and ABCP as a substitute for U.S. Treasuries.

The major contributing factor in the financial crisis was the bundling of subprime mortgages into mortgage-backed securities (MBSs) as well as asset-backed securities (ABSs) in the form of ABCP. The main *trigger* of the financial crisis, as described by former U.S. Federal Reserve Chairman Ben Bernanke, was the prospect of losses on subprime mortgages. Before 2007, housing prices in the United States and other developed nations showed an increase in prices. In the first half of 2007, housing prices in the United States started to decline, causing several subprime mortgage lenders to file for bankruptcy and subsequently fail. These losses became amplified as they had a ripple effect that spread to the main *vulnerabilities* of the crisis, ABCP and repurchase agreements.

When housing prices declined and homeowners defaulted on their mortgage loans, it reduced the value and prices of ABCP (which held mortgages). When it came time for the shadow bank to reissue ABCP, institutional investors were not willing to finance the reissue with continued deposits. This issue resulted in a bank run on the shadow bank and the start of a liquidity crisis.

During the same time period of 2007 and 2008, MMFs contained a high percentage of ABCP. The declining ABCP prices resulted in a run on MMFs by institutional and other large investors, which further exacerbated the liquidity crisis as investors withdrew their money.

The liquidity crisis continued to spread into repo agreements with the average haircut going from near zero at the beginning of 2007 to 25% by September of 2008 at the announcement of the bankruptcy of investment banking firm Lehman Brothers. The increase in the haircut further exacerbated the liquidity crisis with each 1% increase in the haircut translating into a $10 billion withdrawal of liquidity from the financial markets.

LEHMAN BROTHERS FAILURE

LO 8.3: Assess the consequences of the Lehman failure on the global financial markets.

Before Lehman Brothers filed bankruptcy in September 2008, it was the fourth largest investment bank in the United States. The downfall of Lehman was its large exposure to subprime mortgages in the form of owning companies that underwrote the mortgages and also in issuing MBSs that contained subprime mortgages. The bankruptcy filing in September 2008 is considered the tipping point in the financial crisis. It eroded confidence in financial institutions and caused a run on money market mutual funds. This lack of confidence spread across markets and countries, resulting in banks holding onto cash, thereby amplifying losses in the subprime mortgage market.

PREVIOUS FINANCIAL CRISES

LO 8.4: Describe the historical background leading to the recent financial crisis.

It is important to define what a banking crisis is to fully understand the recent financial crisis. A **banking crisis** can be characterized by either of the following occurring: (1) a run on banks that leads to a merger, takeover by the government, or closure of a financial institution, or (2) a merger, takeover, government assistance, or closure of a financial institution that spreads to other financial institutions.

The recent financial crisis has been described as being the worst financial crisis since the Great Depression of the 1930s. Two studies were done using long-term historical data going back before the Great Depression. A study by Schularick and Taylor (forthcoming)[1] showed that an increase in credit in the form of bank loans is a strong predictor of a financial crisis. The data in this study shows that just before the Great Depression the amount of bank loans per GDP peaked and declined sharply after the start of the Great Depression. A study done by Reinhart and Rogoff (2011)[2] shows that an acceleration in economy-wide leverage in the form of external debt (debt borrowed from foreign lenders) and domestic government debt precedes a bank crisis, and these bank crises lead to sovereign debt crises.

When relating these studies to the most recent financial crisis, we see some parallels. In the recent financial crisis, there was a credit boom as evidenced by the growth of MBSs. The mortgage-backed securities were the result of households borrowing more to buy homes. The increased borrowing was linked to reduced lending standards and lenders willing to lend more as housing prices increased—using the house as collateral as it became more valuable. The securitization of mortgages by the shadow banks into ABS and residential mortgage-backed securities (RMBS) was unprecedented in the amount being issued. The private-label securitization (e.g., creation of ABS and RMBS by shadow banks) grew from just under $500 billion in 2000 to over $2 trillion in the year before the crisis. Note that these figures include other forms of securitized products, such as collateralized debt obligations (CDOs) and a derivative of a CDO called CDO squared. The important point is that the growth of these products was evidence of a credit boom, which typically becomes prevalent before a financial crisis.

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[1] Moritz Schularick and Alan M. Taylor, "Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870–2008," *American Economic Review (forthcoming)*.

[2] Carmen M. Reinhart and Kenneth S. Rogoff, "From Financial Crash to Debt Crisis," *American Economic Review* 101(5) (2011): 1676–706.

A separate study done by Reinhart and Rogoff (2008)[3] of five major bank crises in developed countries from 1977 to 1992 showed significant increases in housing prices just before the bank crises followed by significant declines in economic activity afterward. Their data also showed the significant increases in U.S. housing prices just before 2007. In addition, their study illustrated similarities to the run-up in housing prices with other run-ups of real growth rates in equity price indices, real GDP growth per capita, and growth in public debt, all preceding the recent financial crisis.

Another phenomenon that played a significant role in the recent financial crisis was the large amount of institutional cash pools created in the decade before the crisis. These cash pools created the demand in part for the ABSs, MBSs, CDOs, et cetera. As previously mentioned, there was simply too much cash available from institutional investors in relation to the availability of traditionally safe investments like U.S. Treasuries. The institutional cash pools grew from $200 million in 1990 to almost $4 trillion just before the crisis.

The conclusion of these studies is that the financial crisis of 2007–2009 was not unique and followed a pattern of increased public and private debt, increased credit supply, and increased housing prices preceding and leading to the crisis.

PANIC PERIODS

LO 8.5: Distinguish between the two main panic periods of the financial crisis and describe the state of the markets during each.

The two main panic periods of the financial crisis were August 2007 and September 2008 through October 2008. The first panic period in August 2007 occurred when there were runs on ABCP. As previously mentioned, ABCP was sold as an interest paying long-term debt asset that bundled credit card receivables, mortgages, and other loans. As housing prices decreased in early 2007, homeowners started defaulting on their mortgage loans causing the value of ABCP to decrease. Holders of ABCP, namely MMFs, experienced a decrease in value of their assets. At the time, MMFs were thought to be a safe haven by investors.

With the decrease in value of ABCP, the first runs on shadow banks occurred in August 2007. A run can be defined as an institutional investor not willing to invest (deposit) more cash with the shadow banks that issue the ABCP as the ABCP matures. By the end of 2007, approximately 40% of shadow banks issuing ABCP were experiencing runs and having difficulty reissuing ABCP. This resulted in a reduction in the issuance of ABCP by $350 billion, which negatively impacted the balance sheets of those shadow banks.

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[3] Carmen M. Reinhart and Kenneth S. Rogoff, "Is the 2007 U.S. Sub-Prime Financial Crisis So Different? An International Historical Comparison," *American Economic Review* 98(2) (2008): 339–44.

Since MMFs at the time included a large portion of ABCP in their portfolios, the run on the shadow banks spread to MMFs. This action represented the first signs of contagion, which spread to other nonmortgage-related assets. This contagion continued into the interbank system between countries and ultimately caused a global recession. With the value of ABCP decreasing in the typical MMF portfolio, the MMFs were in turn bailed out by their sponsors (banks or mutual fund families that managed MMFs). The bailouts were necessary to maintain the net asset value of $1 per share in the MMFs. Interestingly, MMFs were still perceived as safe havens by investors due to the fund sponsors continuing to bail them out. By September 2008, the start of the second panic period, the amount of money flowing into MMFs had increased by over 50% to over $3 trillion (compared to the start of the ABCP crisis).

The second panic period started when Lehman Brothers filed for bankruptcy, which caused a major shock to MMFs. Lehman was the major issuer of MBSs, which contained subprime mortgages, and also owned subprime mortgage lenders, which subsequently went out of business.

In addition, during the time from July 2007 to the eve of Lehman Brothers filing for bankruptcy, haircuts on repo agreements rose from near zero to just over 25% along with downgrades of MBSs. The rise in haircuts caused other nonmortgage-related short-term debt to fall in value. Under normal circumstances, Lehman would invest cash from an institutional investor in return for issuing the repo agreement and collateral back to the investor. As insurance, the investor would get their cash back plus interest, known as the repo rate. The rise in haircuts meant that Lehman would have to provide significantly more collateral, which they were not able to do with the downgrade in MBSs and the failure of their subprime mortgage lenders. Ultimately, the rise in haircuts prevented Lehman access to financing in the repo markets, which led to its downfall.

Lehman's failure caused a run on a particular MMF called **Reserve Primary**, which contained commercial paper issued by Lehman. The run on Reserve Primary spread to other MMFs, starting a contagion effect that spread to other assets that were falling in price in tandem with rising haircuts. This further spread the contagion to the interbank system and to Europe.

GOVERNMENT POLICY RESPONSES

LO 8.6: Assess the governmental policy responses to the financial crisis and review their short-term impact.

The International Monetary Fund (IMF) (2009)[4] studied 13 developed countries and their responses to the financial crisis, which resulted in 153 separate policy actions (the United States accounted for 49 of those actions). These 153 actions were divided into 5 subgroups consisting of interest rate change, liquidity support, recapitalization, liability guarantees, and asset purchases. The classification of events is shown in Figure 1.

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[4] International Monetary Fund, *Global Financial Stability Report, October 2009: Navigating the Financial Challenges Ahead* (Washington, D.C.: International Monetary Fund, 2009).

Figure 1: Classification of Events*

Central Bank—Monetary Policy and Liquidity Support

Interest rate change

- Reduction of interest rates

Liquidity support

- Reserve requirements, longer funding terms, more auctions, and/or higher credit lines

Government—Financial Sector Stabilization Measures

Recapitalization

- Capital injection (common stock/preferred equity)
- Capital injection (subordinated debt)

Liability guarantees

- Enhancement of depositor protection
- Debt guarantee (all liabilities)
- Debt guarantee (new liabilities)
- Government lending to an individual institution

Asset purchases

- Asset purchases (individual assets, bank by bank)
- Asset purchases (individual "bad bank")
- Provisions of liquidity in context of bad asset purchases/removal
- On-balance-sheet "ring-fencing" with toxic assets kept in the bank
- Off-balance-sheet "ring-fencing" with toxic assets moved to a "bad bank"
- Asset guarantees

*Figure reproduced from Table 3.1, International Monetary Fund (2009)

The IMF study divided the crisis into three time periods: Period 1 is the pre-Lehman period from June 1, 2007, to September 15, 2008. Period 2 is global crisis #1 from September 15, 2008, to December 31, 2008. Period 3 is global crisis #2 from January 1, 2009, to June 30, 2009. In each of the three periods, the IMF used event studies to determine the short-term impact of the five different kinds of policy actions.

To determine the success of the actions taken, the IMF used several different indices and spread measures. To measure the impact of interest rate cuts, they used the **economic stress index** (ESI) and the **financial stress index** (FSI). The ESI is a composite of confidence measures from businesses and consumers, nonfinancial firm stock prices, and credit spreads. The FSI is an index representing a composite of stock prices, spreads, and bank credit. Liquidity support was measured using interbank spreads and the FSI. To measure the impact on recapitalization, liability guarantees, and asset purchases, the IMF study used the FSI and an index of credit default swaps (CDSs) on banks.

Interest Rate Cuts

The central banks of all regions studied the impact of interest rate cuts with the result being no short-term impact on the ESI and only a limited positive effect on the FSI. The conclusion was that the central bank actions were anticipated (event studies do not pick up events that are already anticipated).

Liquidity Support

The effect of liquidity support was measured using the FSI and interbank spreads. During the pre-Lehman period, a strong positive effect was indicated by both measures. In the later measurement periods, the results were indeterminate, which was thought to be due to liquidity support actions being anticipated or because solvency was of a greater concern at that time than liquidity.

Recapitalization

The effect of recapitalization (e.g., the government stepping in to purchase equity in a bank or distressed assets in an effort to restructure the debt and equity of the bank by issuing new forms of debt and equity) had a positive effect. The index of CDS spreads on banks resulted in spreads getting smaller in almost all countries in the study during the second and third periods of the crisis. There were few recapitalizations in the first period, thus, the effect is not noticeable there. When the FSI was used to measure the effects of recapitalization, the result was not as strong, which was thought to be due to the broader nature of the FSI and the benefit of recapitalization going mostly to bondholders.

Liability Guarantees and Asset Purchases

Liability guarantees and asset purchases generally showed weaker results regarding their short-term impact on the crisis. Both the FSI and CDS index were used to measure the effectiveness of these measures. There were two notable exceptions, which were the success of the UK's asset protection scheme of 2009 and the purchase of USB assets by the Swiss government.

The evidence suggests that the most effective measures taken were the liquidity support stabilizing the interbank markets in the pre-Lehman period, but not in the latter two periods, and recapitalization (i.e., capital injections), which was considered the most effective tool in the latter two periods.

GLOBAL EFFECTS ON FIRMS AND THE ECONOMY

LO 8.7: Describe the global effects of the financial crisis on firms and the real economy.

Three different studies were done showing the effects of the global financial crisis on corporations (two studies) and consumers (one study). All three studies pointed out that as the global recession deepened, the demand for credit decreased. This was a reasonable assumption, yet the studies concluded that even with a decrease in demand for credit, there was reduced supply of credit by banks and financial intermediaries.

The first study done by Ivashina and Scharfstein (2010)[5] pertained to how the crisis affected lending to corporations, specifically syndicated loans. **Syndicated loans** are the main source of loans made to large corporations and is the catch-all phrase for loans made by traditional regulated banks and other entities, such as investment banks, mutual funds, insurance companies, pension funds, hedge funds, and other institutional investors. This study found that the amount of syndicated loans started to fall in the middle of 2007 with the decrease in lending accelerating in the fourth quarter of 2008 coinciding with the start of the bank panic. The findings showed lending volume in the fourth quarter of 2008 was 79% lower than at the peak of the lending boom in the second quarter of 2007. A curious finding of the study was that as syndicated lending was down, commercial and industrial lending from regulated banks was up. The explanation for this was that commercial and industrial borrowers were simply accessing their credit lines that had been negotiated before the financial crisis.

The second study done by Puri, Rocholl, and Steffen (2011)[6] focused on consumer loans, specifically how the U.S. crisis affected lending in Germany. The banking system in Germany is structured differently than in the United States and is more decentralized and locally focused. The German banks had exposure of varying degrees to U.S. subprime mortgages with the ones with greater exposure reducing their supply of credit to consumers more than the banks with less exposure to the subprime mortgages. The prevalence of loan applications being rejected became more pronounced with mortgage applications than consumer loans, once again concluding a reduced supply of bank loans.

The third study by Campello, Graham, and Harvey (2010)[7] focused on the effects of the crisis in 2008 on nonfinancial firms in North America, Europe, and Asia comprising 39 countries. The authors asked 1,050 chief financial officers (CFOs) if their operations were "not affected," "somewhat affected," or "very affected" by the problems in the credit markets. The responses were then grouped into two categories of either "constrained," containing the "very affected" firms, or "unconstrained," containing the "not affected" or "somewhat affected" responses. While all firms surveyed cut back on expenditures, cash holdings, number of employees, and dividend payments, it was the constrained firms that were affected more. Key findings from their report were as follows:

- Unconstrained firms reduced the number of employees on average by 2.7%, whereas constrained firms reduced the number of employees by almost 11%.
- 17% of constrained firms drew down their credit compared to 6% of unconstrained firms.
- 20% of constrained firms cited problems with their lines of credit, with 81% of those firms experiencing less access to credit.
- 86% of constrained firms bypassed attractive investments compared to 44% of unconstrained firms.

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[5] Victoria Ivashina and David Scharfstein, "Bank Lending During the Financial Crisis of 2008," *Journal of Financial Economics* 97(3) (2010): 319–38.

[6] Manju Puri, Jörg Rocholl, and Sascha Steffen, "Global Retail Lending in the Aftermath of the US Financial Crisis: Distinguishing Between Supply and Demand Effects," *Journal of Financial Economics* 100(3) (2011): 556–78.

[7] Murillo Campello, John R. Graham, and Campbell R. Harvey, "The Real Effects of Financial Constraints: Evidence from a Financial Crisis," *Journal of Financial Economics* 97(3) (2010): 470–87.

KEY CONCEPTS

LO 8.1

The main trigger of the financial crisis was the prospect of losses on subprime mortgages. In the first half of 2007, housing prices in the United States started to decline, causing several subprime mortgage lenders to file for bankruptcy and subsequently fail. These losses became amplified as they had a ripple effect that spread to the main vulnerabilities of the crisis, asset-backed commercial paper (ABCP) and repurchase agreements.

LO 8.2

When housing prices declined and homeowners defaulted on their mortgage loans, it reduced the value and prices of ABCP. These declining prices resulted in bank runs on shadow banks and money market mutual funds (MMFs) and signaled the start of a liquidity crisis.

The liquidity crisis continued to spread into repo agreements with the average haircut going from near zero at the beginning of 2007 to 25% by September of 2008 (Lehman Brothers bankruptcy).

LO 8.3

The Lehman Brothers bankruptcy filing in September 2008 is considered the tipping point in the financial crisis. It eroded confidence and caused a run on MMFs. This lack of confidence spread across markets and countries, amplifying losses in the subprime mortgage market.

LO 8.4

The recent financial crisis was not unique compared to previous banking crises. It followed a similar pattern of increased public and private debt, increased credit supply, and increased housing prices preceding and leading to the crises.

LO 8.5

The two main panic periods of the financial crisis were August 2007 and September 2008 through October 2008. The first panic period in August 2007 occurred when there were runs on ABCP. The start of the second panic period was September 2008 when Lehman Brothers filed for bankruptcy.

Lehman's failure caused a run on a particular MMF called Reserve Primary, which contained commercial paper issued by Lehman. The run on Reserve Primary spread to other MMFs, which started a contagion effect that spread to other assets that were falling in price in tandem with rising haircuts.

LO 8.6

The International Monetary Fund (IMF) studied 13 developed countries and their responses to the financial crisis. This resulted in 153 separate policy actions that were divided into 5 subgroups consisting of interest rate change, liquidity support, recapitalization, liability guarantees, and asset purchases.

To measure the impact of interest rate cuts, the IMF used the economic stress index (ESI) and the financial stress index (FSI). Liquidity support was measured using interbank spreads and the FSI. Recapitalization, liability guarantees, and asset purchases were measured using the FSI and an index of credit default swaps (CDSs) on banks.

The evidence suggests that the most effective measures taken were the liquidity support stabilizing the interbank markets before the Lehman failure and recapitalization (capital injections), which was considered the most effective tool after the Lehman failure.

LO 8.7

Studies done on the effects of the global financial crisis on corporations and consumers pointed out that as the global recession strengthened, the demand for credit decreased.

CONCEPT CHECKERS

1. Which of the following most accurately describe the main trigger and main vulnerability of the most recent financial crisis?

	Trigger	Vulnerability
A.	Run on ABCP	Shadow banks
B.	Lehman Brothers bankruptcy	Money market mutual funds
C.	Losses on subprime mortgages	ABCP and repo agreements
D.	Mortgage defaults by homeowners	Holders of MBSs

2. The main vulnerability of commercial paper was:
   A. becoming the choice of financing for corporations.
   B. the inclusion of subprime mortgages in the form of MBSs.
   C. containing short-term debt of corporations whose credit quality diminished.
   D. being made of longer-term debt in the form of credit cards and other consumer loans.

3. The major impact of Lehman Brothers filing for bankruptcy was:
   A. an increase in haircuts.
   B. a run on commercial paper.
   C. a run on money market mutual funds.
   D. a reduction in price of nonmortgage-related securities.

4. Which of the following statements best describe the factors linking the Great Depression to the most recent financial crisis?
   A. A decrease in equity prices and real GDP growth per capita.
   B. An increase in government debt and a decrease in housing prices.
   C. A large amount of cash available for investment by institutional investors in the form of cash pools.
   D. An increase in overall borrowing, an increase in the supply of credit, and an increase in housing prices.

5. Which of the following governmental policy responses to the financial crisis was most effective in the short term?
   A. Liquidity support and recapitalization.
   B. Capital injections and debt guarantees.
   C. Interest rate cuts and asset repurchases.
   D. Liability guarantees and asset repurchases.

CONCEPT CHECKER ANSWERS

1. **C** The main trigger was the prospect of losses on subprime mortgages. The losses on subprime mortgages caused MBSs to be downgraded, causing a run on ABCP that contained the MBSs. As liquidity tightened and confidence in the financial system eroded, it caused the haircut on repo agreements to dramatically increase, further reducing the repo market and overall liquidity in the financial markets.

2. **B** During the financial crisis of 2007–2009, a significant amount of the mortgages in ABCP were subprime mortgages, which subsequently became worthless as MBSs were downgraded. Thus, the ABCP became vulnerable as investors withdrew their money from the shadow banks that were issuing ABCP.

3. **C** The major impact of Lehman filing for bankruptcy was a run on money market mutual funds starting with Reserve Primary. Reserve Primary contained Lehman commercial paper. After the bankruptcy filing, Reserve Primary was not able to maintain their $1 net asset value, which resulted in a run on Reserve Primary by investors. This led to a run on other money market mutual funds, starting a contagion effect that spread to other nonmortgage-related assets and other financial markets.

4. **D** Similarities between the cause of the Great Depression and the most recent financial crisis are an increase in overall borrowing by the public and private sectors, an increase in the supply of credit, and an increase in housing prices. The increase in equity prices and real GDP growth per capita were also similarities between both financial crises. Large cash pools were a phenomenon unique to the most recent financial crisis.

5. **A** Liquidity support in the pre-Lehman period and recapitalization after the Lehman bankruptcy proved to be the most effective policy tools in the short term.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

RISK MANAGEMENT FAILURES: WHAT ARE THEY AND WHEN DO THEY HAPPEN?

Topic 9

EXAM FOCUS

Risk management failures result from not correctly recognizing, measuring, and/or monitoring risks as well as not appropriately communicating these risks to top management. Mismeasurement of risk can result from not recognizing how return distributions change, using subjective inputs concerning rare events, and failing to take all risks into account. For the exam, understand the use of value at risk (VaR) as a risk metric. VaR is a very useful tool for measuring and monitoring market, credit, and operational risk.

THE ROLE OF RISK MANAGEMENT

LO 9.1: Explain how a large financial loss may not necessarily be evidence of a risk management failure.

The role of risk management involves performing the following tasks.

- Assess all risks faced by the firm.
- Communicate these risks to risk-taking decision makers.
- Monitor and manage these risks (make sure that the firm only takes the necessary amount of risk).

The risk management process focuses on the output of a particular risk metric [e.g., the value at risk (VaR) for the firm] and attempts to keep the measure at a specified target amount. When a given risk measure is above (below) the chosen target amount, the firm should decrease (increase) risk. The risk management process usually evaluates several risk metrics (e.g., duration, beta).

A large loss is not necessarily an indication of a risk management failure. As long as risk managers understood and prepared for the possibility of loss, then the implemented risk management was successful. With that said, the main objective of risk management should not be to prevent losses. However, risk management should recognize that large losses are possible and develop contingency plans that deal with such losses if they should occur.

INCORRECTLY MEASURING AND MANAGING RISK

LO 9.2: Analyze and identify instances of risk management failure.

LO 9.3: Explain how risk management failures can arise in the following areas: measurement of known risk exposures, identification of risk exposures, communication of risks, and monitoring of risks.

The process of risk management can fail if one or more of the following events occur.

- Not measuring known risks correctly.
- Not recognizing some risks.
- Not communicating risks to top management.
- Not monitoring risk adequately.
- Not managing risk adequately.
- Not using the appropriate risk metrics.

It is important for the firm to recognize all relevant risks and to measure all known risks correctly. These risks need to be managed and monitored using the appropriate risk metrics, and the results need to be properly communicated to top management.

Risk mismeasurement can occur when risk managers do not understand the distribution of returns of a single risky position or the relationships of the distributions among different positions. Understanding the distribution of a given position means being able to identify the underlying return distribution and the probabilities associated with that particular distribution. Understanding the relationships among return distributions means being able to identify how risky positions are correlated. In both cases, it is crucial to understand the degree to which return distributions and/or correlations can change over time. It is well known, for example, that correlations tend to increase during times of stress.

One of the key issues for risk managers is the occurrence of extreme events (those events which occur with low frequency, but high severity). Estimates of these rare events require a degree of subjectivity, which clearly has the potential for mismeasurement. Unfortunately, firm politics can play a role in reducing the accuracy of risk estimates since some departments may wish to understate risks by using subjective measures. Mismeasurement can also occur from ignoring relevant risks.

Failing to take known and unknown risks into account (i.e., ignoring risks) can take three forms:

1. Ignoring a risk that is known.
2. Knowing about a risk, but failing to properly incorporate it into risk models.
3. Failing to discover all risks.

A firm ignores known risks by failing to realize how various position risks can lead to a potential disaster. This was the case when Long-Term Capital Management (LTCM) failed to recognize that high-yielding Russian debt had not only default risk, but also currency risk, sovereign risk, and counterparty risk. For example, the managers of LTCM had thought they had hedged currency risk by selling rubles forward, but the Russian banks on the other sides of the transactions failed during the 1998 Russian crisis.

Not collecting and entering data into the appropriate risk models is another potential source of disaster. In this case, the firm may make an attempt to recognize the risk. However, not obtaining proper data to measure the risk adequately will have similar consequences to ignoring risks.

One of the severe consequences of either ignoring or not adequately using data in risk models is that the firm might expand its operations in areas where risks are not being properly accounted for. For example, consider a particular trading office within a firm where the firm has made a risk allocation to the office, but then the firm ignores the data generated by this trading office and does not monitor to see if allocation adjustments are needed. Another example is blindly accepting a given assumption (i.e., AAA-rated assets are very low risk) and ignoring data that would indicate the contrary.

Another risk that is often ignored is increasing correlations during a time of crisis. Not recognizing the possibility of increasing correlations could potentially lead to large losses. Consider, for example, the correlation between credit risk and market risk for banks. In the recent credit crisis, market risk caused decreases in security values issued through securitization, and credit risk caused decreases in the utilization of securitization. The important point is that firms must use all available data to adequately measure all risks and relationships among risks.

Some risks may go completely undetected by risk managers. Clearly, the same unfavorable outcomes discussed previously would result. In some cases, however, unknown risks may not be too severe of a problem. There are ultra-extreme events (e.g., asteroid crashing to earth) where the probability is so low and the outcome is so horrific that exploring it would not be worthwhile. Also, the nature of some risks can be unknown while their consequences are known. For example, simply knowing that a given random variable follows a normal distribution may be adequate. Furthermore, as long as management realizes that not all risks will be known and makes appropriate capital allocations to account for this, then unknown risks may not be a severe problem.

PROPERLY COMMUNICATING RISKS

The purpose of risk management is to allow senior managers of the firm to make the optimal strategic decisions to maximize firm value. Thus, risk management efforts are wasted unless the results can be effectively communicated to the appropriate decision makers. This includes timely communication that has not been distorted by intermediaries. Furthermore, the risk management process may be harmful if there is miscommunication, and the senior managers get a false sense of security from the information that is provided. The bottom line is this—it is very important to communicate the results of the risk management process effectively.

ONGOING RISK MANAGEMENT

Risk managers must recognize how portfolio risk profiles can change even during the absence of trading. The properties of some securities can change for several reasons (e.g., changes in interest rates, embedded derivatives). Also, some securities can have complex relationships with market variables; for example, a security may increase in value when interest rates decline over one particular range and then decline in value as interest rates decline further outside of that range.

The pricing of subprime derivatives serves as an example of changing risk exposures. Previously, the ABX indices (i.e., asset-backed securities indices) showed no variation for AAA-rated tranches of securitization. However, during the recent financial crisis, the values declined suddenly and dramatically, and anyone who had relied on historical values of the ABX indices for allocations incurred large losses. Obviously, a key element for successful risk management is to recognize how quickly and dramatically risk characteristics can change. Thus, it is important to be able to respond quickly and have contingency plans if/when needed.

It is also important to understand that the act of monitoring and managing risk can change the nature of risk. The **Heisenberg Principle** says that increasing the certainty for one variable may introduce uncertainty for another variable. Marking to market in one firm, for example, may start a chain reaction of adjustments in other firms which changes the risk characteristics of those firms and the overall market, thus, increasing market risk.

Another cautionary note concerning monitoring and managing risk too carefully is that it could stifle a trading department's innovation. Employees should have some degree of flexibility; therefore, a firm's management may rightly decide not to, or "fail" to, monitor and manage some risks on an ongoing basis. The downside of course is that this flexibility could make it possible for risks to emerge in remote corners of the firm. This is one of the many trade-offs senior management must consider.

Firms can fail to monitor and manage risk on an ongoing basis by not having an adequate incentive structure and/or culture that promotes effective risk management. If risk is everyone's concern, then unobserved risks are less likely. In addition, if compensation is a function of risk, then employees will likely take more interest in lowering firm risk.

The Role of Risk Metrics

LO 9.4: Evaluate the role of risk metrics and analyze the shortcomings of existing risk metrics.

Risk metrics aid the management process by providing managers a target to achieve (e.g., a particular VaR level). Monitoring these risk metrics allows managers to appropriately manage risk. However, risk metrics may be too narrow in scope, which can make it more difficult to achieve the overall objective of managing risk in an effort to create value.

VaR is a widely used risk metric that is narrow in scope in several ways. Usually, a firm simply reports the number of times losses exceeded VaR in a given period. Over a year, a firm may have zero daily losses greater than daily VaR, but it could end up with an annual loss in the event that most days incurred losses (without exceeding VaR). Furthermore, for a firm that exceeds its VaR for a certain number of days, the VaR approach does not indicate the size of those losses. It is well known that VaR does not capture the implications of extremely large losses that have a very low probability of occurring.

One misuse of VaR is choosing a time period (e.g., daily or weekly) that does not correspond to the liquidity of the assets in the portfolio. Using daily VaR on a portfolio where the assets cannot be effectively traded within a day is clearly not appropriate. Taking a longer term horizon to account for liquidity of the assets may not be sufficient either. The problem is that any given horizon, such as a month or a year, may have a low probability of default because the probability of a crisis in these intermediate horizons is very low. Financial institutions generally focus on firm-wide risk management at a one-year horizon and try to achieve credit ratings that imply a low probability of default for that horizon. However, without looking ahead multiple periods, the firm has little incentive to factor in a potential crisis, which would drastically change default probabilities. The firm needs a strategy to survive those unfortunate years where crises do occur, which means that focusing on only a one-year horizon will likely fall short.

VaR also assumes the distributions of losses are not correlated over time. In the recent financial crisis, huge losses on one day led to drastic falls in liquidity, which led to large losses on the following day. The fact is that a crisis can change the nature of a return distribution for a given period as well as across periods.

Another complication is that a given firm's losses can exacerbate the risk in the overall market. This is related to an earlier discussion on how the marking to market of one firm can lead to adjustments in other firms. The point is that a firm with large losses in a given market can influence the activity in that market. This firm can also fall victim to predatory trading. **Predatory trading** occurs when other firms in a market see that a large player in the market is in trouble and the other firms attempt to push the price down further in order to hurt the large player. Such activity is difficult to incorporate into risk metrics.

In its risk management process, a firm can attempt to capture such complications with scenario analysis. The scenarios would include a crises and/or a firm's behavior in the overall market. Scenario analysis requires input from people who have a solid understanding of not only mathematics, but also the complexities of human behavior.

KEY CONCEPTS

LO 9.1

Risk management involves assessing, communicating, monitoring, and managing risks.

A large loss does not necessarily mean that risk management has failed. Losses are the result of risk taking, which is required for value creation.

LO 9.2

Risk management can fail if the firm does not do the following: measure risks correctly, recognize some risk, communicate risks to top management, monitor and manage risks, and use appropriate metrics.

LO 9.3

Mismeasurement can occur when management does not understand the distribution of returns of a single position or the relationships of the distributions among positions and how the distributions and correlations can change over time. Mismeasurement can also occur when managers must use subjective probabilities for rare and extreme events. The subjective probabilities can be biased from firm politics.

Failing to take known and unknown risks into account can take three forms: (1) ignore a risk that is known, (2) failure to incorporate a risk into risk models, and (3) not finding all risks. All three of these are variations of the same concept and can have similar results (e.g., failure to measure overall risk or expanding operations to areas where risk is not being properly measured).

Senior managers must understand the results of risk management in order for it to be meaningful. Unless senior managers have the correct information to make decisions, risk management is pointless.

Risk managers must recognize how risk characteristics change over time. Many securities have complex relationships with market variables. Having an adequate incentive structure and firm-wide culture can help with the risk monitoring and managing process.

LO 9.4

Risk metrics such as VaR are usually too narrow in scope. For example, VaR usually assumes independent losses across periods of time. Risk metrics generally fail to capture the effect of a firm's actions on the overall market and behavior patterns such as predatory trading.

CONCEPT CHECKERS

1. Which of the following is not part of the risk management process?
   A. Monitoring risk.
   B. Assessing the risks faced by the firm.
   C. Properly communicating the risks to upper management.
   D. Reducing the probability of loss to as close to zero as possible.

2. Paul Frank, FRM, manages several positions within a portfolio. He has determined all possible outcomes for every single position. The result of his detailed work means that:
   A. risk mismeasurement is not possible.
   B. risk mismeasurement is still possible for each of the positions and the overall portfolio.
   C. risk mismeasurement is only possible if the possible outcomes change and Frank does not make the necessary adjustments.
   D. risk mismeasurement is not possible for each of the positions, but it is possible for the overall portfolio because correlations have not been addressed.

3. The Tower Corporation has several divisions, and each must give updated reports on its risk levels. The nature of Tower's business is that there is the possibility of large losses that are very infrequent, some of which have never actually been realized. Tower requires that the manager of each division include subjective assessments of these risks in their reports. With respect to this risk assessment, which of the following statements is most accurate? This action:
   A. is the best way to avoid risk mismeasurement.
   B. is always an appropriate method for managing risk.
   C. can be a source of risk mismeasurement, but Tower can expect the errors to be unbiased.
   D. can be a source of risk mismeasurement due to the subjective input and the fact that there may be bias in the input.

4. If risk managers are not certain of all risks faced by the firm:
   A. the firm will most likely fail.
   B. this can be a source of risk management failure, but not in all cases.
   C. this is a cause of risk management failure and is always avoided with adequate research.
   D. this is a source of risk management failure and usually cannot be avoided with adequate research.

5. Crane Corporation has a multi-tier management structure. Risk management occurs in each division at the base level of the structure (i.e., in each division). The results of the process are then successfully communicated to higher tiers, where it is reviewed and revised at each tier, and then sent to the appropriate decision makers for the firm. This process is:
   A. not appropriate because it allows for distortions between the managers of risk and the decision makers.
   B. not appropriate because risk management should not be done at the base level of a corporation.
   C. appropriate, and it would also be appropriate to have the base tier report directly to the top management tier.
   D. appropriate because it allows for maximum input into the process.

CONCEPT CHECKER ANSWERS

1. **D** Some losses are to be expected if risk taking is aimed at creating value.

2. **B** Frank must also consider the probabilities of the outcomes and not just the outcomes themselves. He must also consider the correlations across positions.

3. **D** Subjective inputs will have random errors and, in this case, may very well exhibit bias because each manager likely has a motive to understate risk.

4. **B** Some risks may not be known explicitly, but they can still be accounted for. In this case, risk management can still be successful. Also, not knowing the risks themselves but understanding the results of the risk (i.e., the distribution of returns) can be adequate for successful risk management.

5. **A** The fact that intermediate tiers can modify the information without being directly involved in the risk management process can introduce distortions.

DELINEATING EFFICIENT PORTFOLIOS

EXAM FOCUS

This optional reading addresses fundamental concepts regarding portfolio return and volatility. Be familiar with the calculations of expected return and volatility for a two-asset portfolio and understand the importance of correlation in portfolio diversification. It is also important to understand the shape of the portfolio possibilities curve and what is meant by the minimum variance portfolio. Additionally, you should know what the efficient frontier looks like and how short sales and riskless borrowing affect it. We have included Concept Checkers at the end of this reading for additional practice with these concepts.

EXPECTED RETURN AND VOLATILITY OF A TWO-ASSET PORTFOLIO

The expected return on a portfolio is a weighted average of the expected returns on the individual assets that are included in the portfolio. For example, for a two-asset portfolio:

$$E(R_P) = w_1E(R_1) + w_2E(R_2)$$

where:
$E(R_P)$ = expected return on Portfolio P
w_i = proportion (weight) of the portfolio allocated to Asset i
$E(R_i)$ = expected return on Asset i

The weights (w_1 and w_2) must sum to 100% for a two-asset portfolio.

The variance of a two-asset portfolio equals:

$$\sigma_P^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\text{Cov}_{1,2}$$

where:
σ_P^2 = variance of the returns for Portfolio P
σ_1^2 = variance of the returns for Asset 1
σ_2^2 = variance of the returns for Asset 2
w_i = proportion (weight) of the portfolio allocated to Asset i
$\text{Cov}_{1,2}$ = covariance between the returns of the two assets

The covariance, $\text{Cov}_{1,2}$, measures the strength of the relationship between the returns earned on assets 1 and 2. The covariance is unbounded (ranges from negative infinity to positive infinity); therefore, it is not a very useful measure of the strength of the relationship between two asset's returns. Instead, we often scale the covariance by the standard deviations of the two assets to derive the correlation coefficient, $\rho_{1,2}$:

$$\rho_{1,2} = \frac{\text{Cov}_{1,2}}{\sigma_1 \sigma_2}$$

From the previous equation, notice that the covariance equals $\rho_{1,2}\sigma_1\sigma_2$. Therefore, the variance of the two-asset portfolio can also be written as:

$$\sigma_P^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{1,2}\sigma_1\sigma_2$$

The portfolio standard deviation or portfolio volatility is the positive square root of the portfolio variance.

$$\sigma_P = \left[w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{1,2}\sigma_1\sigma_2\right]^{1/2}$$

Example: Expected return and volatility for a two-asset portfolio

Using the information in the following figure, **calculate** the expected return and standard deviation of the two-asset portfolio.

Characteristics for a Two-Stock Portfolio

	Caffeine Plus	*Sparklin'*
Amount invested	\$40,000	\$60,000
Expected return	11%	25%
Standard deviation	15%	20%
Correlation	0.30	

Answer:

First, determine the weight of each stock relative to the entire portfolio. Since the investments are \$40,000 and \$60,000, we know the total value of the portfolio is \$100,000:

w_c = investment/portfolio value = \$40,000 / \$100,000 = 0.40

w_s = investment/portfolio value = \$60,000 / \$100,000 = 0.60

Next, we determine the expected return on the portfolio:

$$E(R_p) = w_c E(R_c) + w_s E(R_s)$$

$$E(R_p) = (0.40)(0.11) + (0.60)(0.25) = 0.1940 = 19.40\%$$

Then, we calculate the variance of the portfolio:

$$\begin{aligned}\sigma_p^2 &= w_c^2\sigma_c^2 + w_s^2\sigma_s^2 + 2w_c w_s \rho_{cs}\sigma_c\sigma_s \\ &= (0.40)^2(0.15)^2 + (0.60)^2(0.20)^2 + 2(0.40)(0.60)(0.30)(0.15)(0.20) \\ &= 0.02232\end{aligned}$$

And, finally, the standard deviation of the portfolio:

$$\sigma_p = \sqrt{\sigma_p^2} = \sqrt{0.02232} = 0.1494 = 14.94\%$$

THE PORTFOLIO POSSIBILITIES CURVE

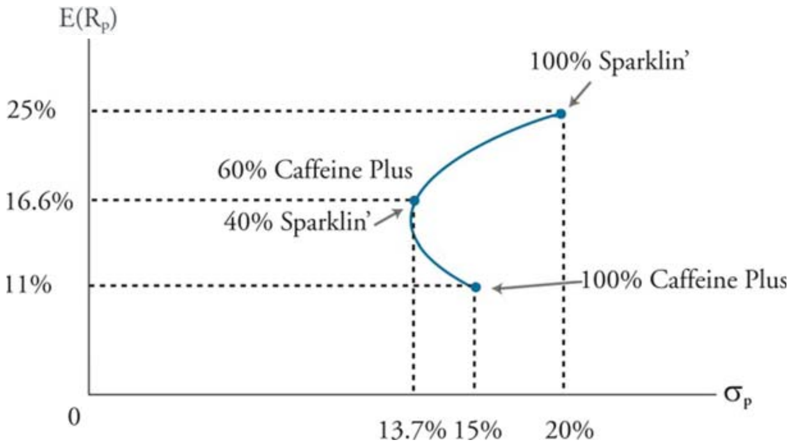
In the Caffeine Plus and Sparklin' example, we calculated the expected return and volatility of one possible combination: 40% in Caffeine Plus and 60% in Sparklin'. However, an infinite number of combinations of the two stocks are possible. We can plot these combinations on a graph with expected return on the *y*-axis and standard deviation on the *x*-axis, commonly referred to as plotting in risk/return "space." The graph of the possible portfolio combinations is referred to as the **portfolio possibilities curve**. Figure 1 shows some of these combinations.

Figure 1: Portfolio Returns for Various Weights of Two Assets

$w_{\text{Caffeine Plus}}$ $w_{\text{Sparklin'}}$	100% 0%	80% 20%	60% 40%	40% 60%	20% 80%	0% 100%
$\hat{R}_p$	11.00%	13.80%	16.60%	19.40%	22.20%	25.00%
σ_p	15.00%	13.74%	13.72%	14.94%	17.10%	20.00%

The plot in Figure 2 represents all possible expected return and standard deviation combinations attainable by investing in varying amounts of Caffeine Plus and Sparklin'.

Figure 2: Expected Return and Standard Deviation Combinations



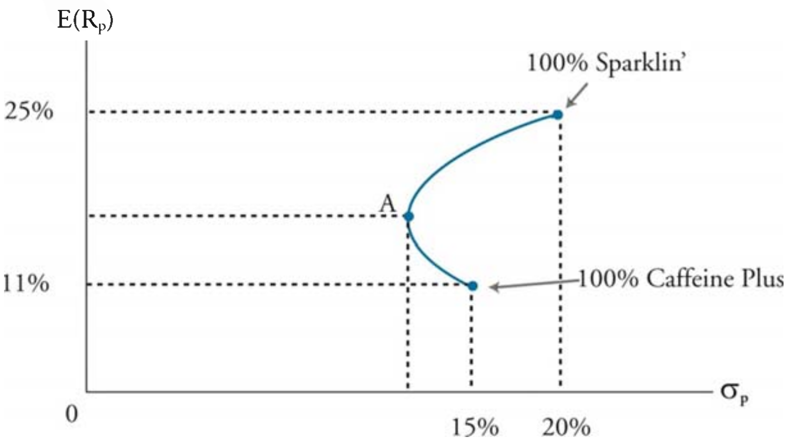
There are several things to notice about Figure 2:

- If 100% of the portfolio is allocated to Caffeine Plus, the portfolio will have the expected return and standard deviation of Caffeine Plus (i.e., Caffeine Plus is the portfolio), and the investment return and risk combination is at the lower end of the curve.
- As the investment in Caffeine Plus is decreased and the investment in Sparklin' is increased, the investment moves up the curve to the point where the portfolio's expected return is 16.6% with a standard deviation of 13.72% (labeled 60% Caffeine Plus/40% Sparklin').
- Finally, if 100% of the portfolio is allocated to Sparklin', the portfolio will have the expected return and standard deviation of Sparklin', and the investment return and risk combination is at the upper end of the curve (e.g., higher risk and higher expected return).

MINIMUM VARIANCE PORTFOLIO

The **minimum variance portfolio** is the portfolio with the smallest variance among all possible portfolios on a portfolio possibilities curve. The minimum variance portfolio consisting of Caffeine Plus and Sparklin' contains approximately 70% Caffeine Plus and 30% Sparklin' and has an expected return of 15.3% and a standard deviation of 13.6%. On the portfolio possibilities curve, the minimum variance portfolio represents the left-most point on the curve. Figure 3 illustrates the minimum variance portfolio for Caffeine Plus and Sparklin' (point A).

Figure 3: Minimum Variance Portfolio



CORRELATION AND PORTFOLIO DIVERSIFICATION

Perfect Positive Correlation

In the case where two assets have perfect positive correlation (i.e., ρ = 1), the portfolio standard deviation reduces to the simple weighted average of the individual standard deviations indicating no diversification. This is shown mathematically as:

$$\sigma_p = \left[w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2 \times 1 \times \sigma_1\sigma_2\right]^{1/2} = w_1\sigma_1 + w_2\sigma_2$$

Since expected portfolio return is a linear combination of the individual asset returns, and risk is a linear combination of the individual asset volatilities, the portfolio possibilities curve for two perfectly correlated assets is a straight line. This line is given as:

$$E(R_P) = \left(E(R_2) - \frac{E(R_1) - E(R_2)}{\sigma_1 - \sigma_2}\sigma_2\right) + \left(\frac{E(R_1) - E(R_2)}{\sigma_1 - \sigma_2}\right)\sigma_P$$

No diversification is achieved if the correlation between assets equals +1. As the correlation between two assets *decreases*, however, the benefits of diversification *increase*. As the correlation decreases, there is less tendency for stock returns to move together. The separate movements of each stock serve to reduce the volatility of a portfolio to a level that is less than the weighted sum of its individual components (e.g., less than $w_1\sigma_1 + w_2\sigma_2$).

Perfect Negative Correlation

The greatest diversification is achieved in the case where two assets have perfect negative correlation (i.e., ρ = −1). In this case, the portfolio standard deviation reduces to two linear equations, which are:

$$\sigma_p = \left[w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2 \times -1 \times \sigma_1\sigma_2\right]^{1/2} = w_1\sigma_1 - w_2\sigma_2 \text{ or } -w_1\sigma_1 + w_2\sigma_2$$

When two assets have perfect negative correlation, it is possible to construct a portfolio with zero volatility by setting the standard deviation equal to zero and solving for the portfolio weights. The portfolio with zero volatility has portfolio weights of:

$$w_1 = \frac{\sigma_2}{\sigma_1 + \sigma_2}$$

$$w_2 = 1 - w_1$$

Given that the standard deviation reduces to two linear equations, the portfolio possibilities curve for two assets with perfect negative correlation will be two line segments.

Zero Correlation

When the correlation between two assets is zero, the covariance term in the portfolio standard deviation expression is eliminated, and the resulting expression is:

$$\sigma_p = \left[w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2 \times 0 \times \sigma_1\sigma_2\right]^{1/2} = \left[w_1^2\sigma_1^2 + w_2^2\sigma_2^2\right]^{1/2}$$

In this case, the standard deviation expression reduces to a non-linear equation, and the portfolio possibilities curve will be non-linear.

Assuming that the standard deviations of the individual assets are greater than zero, it is impossible to construct a portfolio with zero volatility. The weights of the minimum variance portfolio can be solved as previously discussed. The weights are calculated as:

$$w_1 = \frac{\sigma_2^2}{\sigma_1^2 + \sigma_2^2}$$

$$w_2 = 1 - w_1$$

Moderate Positive Correlation

Most equities are positively correlated (i.e., $0 < \rho < 1$). If we assume that two assets are moderately correlated (e.g., $\rho = 0.5$), then the portfolio standard deviation reduces to:

$$\sigma_p = \left[w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2 \times \frac{1}{2} \times \sigma_1\sigma_2\right]^{1/2} = \left[w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + w_1w_2\sigma_1\sigma_2\right]^{1/2}$$

Similar to the case of zero correlation, assets with moderate correlation have non-linear portfolio possibilities curves.

An Example of Correlation and Portfolio Diversification

To illustrate the effects of correlation on diversification, consider the expected return and standard deviation data derived for domestic stocks, DS, and domestic bonds, DB as shown in Figure 4.

Figure 4: Diversification Example

	Expected Return	*Standard Deviation*
Domestic Stocks (DS)	0.20	0.30
Domestic Bonds (DB)	0.10	0.15

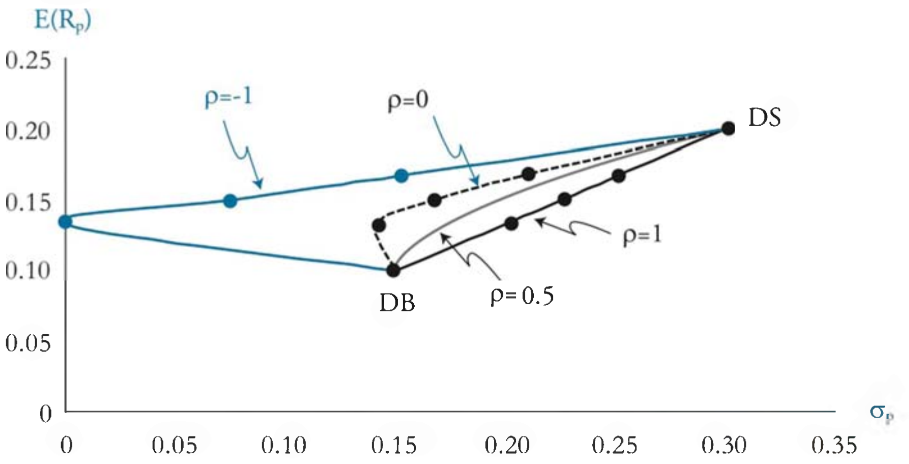
Figure 5 shows the expected return and standard deviation combinations for various portfolio percentage allocations to domestic stocks and domestic bonds for each of the correlations +1, 0.5, 0, and –1.

Figure 5: Expected Return/Standard Deviation Combinations for Various Allocations

					σ_p	
DS % Allocation	*DB % Allocation*	$E(R_p)$	$\rho = 1$	$\rho = 0.5$	$\rho = 0$	$\rho = -1$
100.00	0.00	0.200	0.300	0.300	0.300	0.300
66.67	33.33	0.167	0.250	0.229	0.206	0.150
50.00	50.00	0.150	0.225	0.198	0.168	0.075
33.33	66.67	0.133	0.200	0.173	0.141	0.000
0.00	100.00	0.100	0.150	0.150	0.150	0.150

Figure 6 shows the plot of the expected returns and standard deviations for each of the four correlations.

Figure 6: Effects of Correlation on Portfolio Risk



As indicated in Figure 6, the lower the correlation between the returns of the stocks in the portfolio, the greater the diversification benefits. If the correlation equals +1 (the solid black line), the minimum-variance frontier is a straight line between the two points (DB and DS), and there is no benefit to diversification. If the correlation equals –1 (the solid blue line), the minimum-variance frontier is two straight-line segments, and there exists a portfolio combination of stocks and bonds with a standard deviation of *zero* (the allocation of 66.67% to domestic bonds and 33.33% to domestic stocks).

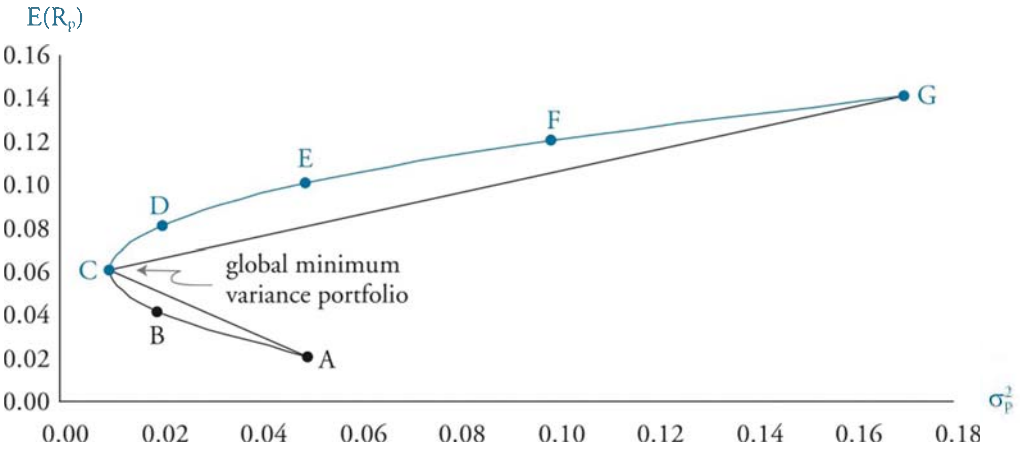
THE SHAPE OF THE PORTFOLIO POSSIBILITIES CURVE

Professor's Note: In this section, we are not considering the special cases where the portfolio possibilities curve is a straight line (i.e., $\rho = 1$) or two line segments (i.e., $\rho = -1$). In all other cases, the portfolio possibilities curve is a curve similar to Figure 7.

Looking at Figure 7, the shape of the portfolio possibilities curve is best described in two pieces.

- The piece of the portfolio possibilities curve that lies above the minimum variance portfolio (from point C through point G) is concave.
- The piece of the portfolio possibilities curve that lies below the minimum variance portfolio (from point A through point C) is convex.

Figure 7: Shape of the Portfolio Possibilities Curve



Professor's Note: A concave function is one where the function lies above a straight-line segment connecting any two points on the function. A convex function lies below a straight-line segment connecting any two points on the function.

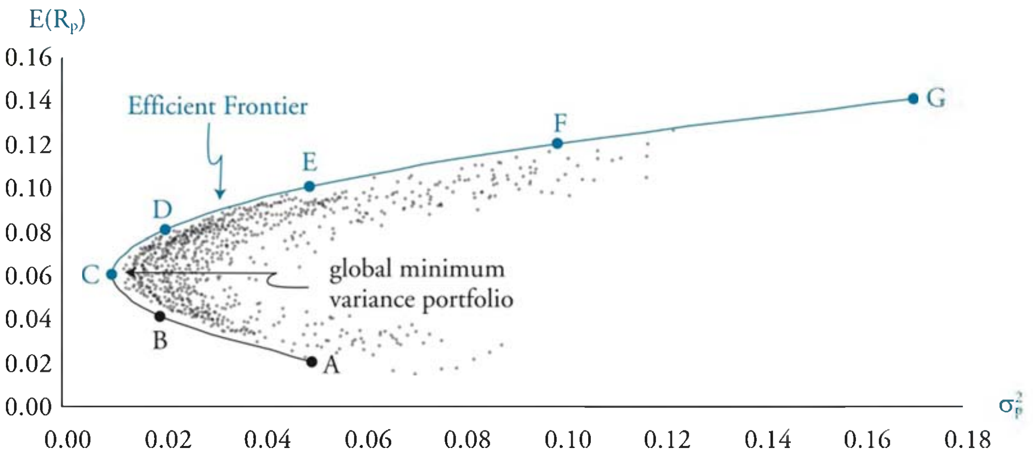
In Figure 7, the function is above the line segment from C to G. Therefore, the portion of the portfolio possibilities curve from C to G is concave. The function is below the line segment from A to C. Therefore, the portion of the portfolio possibilities curve from A to C is convex.

Another important aspect regarding the shape of the portfolio possibilities curve is that the curve must lie to the left of a line segment connecting any two points on the curve. From the discussion of portfolio diversification and correlation, combinations of two assets with perfect positive correlation result in a straight line. Combinations of assets with lower correlation will always lie to the left of that line.

The Efficient Frontier

Plotting all risky assets and potential combinations of risky assets will result in a graph similar to Figure 8.

Figure 8: Efficient Frontier



Notice that the graph includes some portfolios that no rational investor would select. All portfolios lying on the inside of the curve are inefficient. Additionally, some portfolios offer higher returns with identical risk. For example, portfolios A and E have identical risk; however, Portfolio E has a much higher expected return, and a similar contrast exists for Portfolio D versus Portfolio B. All rational investors would prefer Portfolio D over Portfolio B, and Portfolio E over Portfolio A.

Portfolios such as D and E are called **efficient portfolios**, which are portfolios that have:

- Minimum risk of all portfolios with the same expected return.
- Maximum expected return for all portfolios with the same risk.

The **efficient frontier** is a plot of the expected return and risk combinations of all efficient portfolios, all of which lie along the upper-left portion of the possible portfolios (from Point C to Point G in Figure 8).

Short Sales and the Efficient Frontier

When short sales are allowed, the shape of the efficient frontier changes. To examine how it changes, consider again the Caffeine Plus and Sparklin' example.

Referring back to the example, Caffeine Plus has an expected return of 11% and a standard deviation of 15%, and Sparklin' has an expected return of 25% and a standard deviation of 20%. The correlation between Caffeine Plus and Sparklin' is 0.30. Although neither stock has a negative return, it may make sense to short sell one of the stocks. In this case, Sparklin' has a higher expected return, so shorting Caffeine Plus and investing in Sparklin' would expand the efficient frontier. Figure 9 highlights the portfolio return and volatility for combinations of Sparklin' and Caffeine Plus including short sales.

Figure 9: Portfolio Returns for Various Weights of Two Assets (w/ Short Sales)

$w_{\text{Caffeine Plus}}$	100%	80%	60%	40%	20%	0%	–20%	–40%	– 60%	–80%	– 100%
$w_{\text{Sparklin'}}$	0%	20%	40%	60%	80%	100%	120%	140%	160%	180%	200%
$\hat{R}_p$	11.00%	13.80%	16.60%	19.40%	22.20%	25.00%	27.80%	30.60%	33.40%	36.20%	39.00%
σ_p	15.00%	13.74%	13.72%	14.94%	17.10%	20.00%	23.28%	26.82%	30.53%	34.36%	38.28%

When allowing for short sales, the efficient frontier expands up and to the right. By shorting, it is possible to create higher return and higher volatility portfolio combinations that would not be possible otherwise. Theoretically, with no limitations on shorting, it would be possible to construct a portfolio with infinite return.

Professor's Note: Up to this point, we have discussed risky assets. Now, we add the risk-free asset to the set of asset choices and examine the effect it has on investment choices.

Combining the Risk-Free Rate with the Efficient Frontier

So far, our portfolios have consisted of risky assets only. However, in reality, investors usually allocate their wealth across both risky and risk-free assets. The following discussion illustrates the effects of the inclusion of the risk-free asset. A risk-free asset is a security that has a return known ahead of time, so the variance of the return is zero.

Consider the task of creating portfolios comprising the risk-free asset, F, and a risky portfolio, P. Assume that Portfolio P lies on the efficient frontier of risky assets. Various combinations (weightings) of Portfolio P and the risk-free asset can be created. By adding the risk-free asset to the investment mix, a very important property emerges: *The shape of the efficient frontier changes from a curve to a line.*

Recall that the expected return for a portfolio of two assets equals the weighted average of the asset expected returns. Therefore, the expected return on Investment C that combines the risk-free asset and risky Portfolio P equals:

$$E(R_C) = w_F R_F + w_P E(R_P)$$

where:

w_F = percentage allocated to the risk-free asset
w_P = percentage allocated to Portfolio P

Also, recall that the variance of the portfolio of two assets (F and P) equals:

$$\sigma_C^2 = w_F^2\sigma_F^2 + w_P^2\sigma_P^2 + 2w_F w_P \text{Cov}_{FP}$$

where:

σ_C^2 = variance for Investment C
σ_F^2 = variance for the risk-free asset
σ_P^2 = variance for Portfolio P
Cov_{FP} = covariance between F and P

Observe that since we know that the variance and the standard deviation of the risk-free asset both equal zero, and that the covariance of the risk-free asset with any risky asset also equals zero, the equations for the variance and standard deviation for Investment C simplify to:

$$\sigma_C^2 = w_P^2\sigma_P^2$$

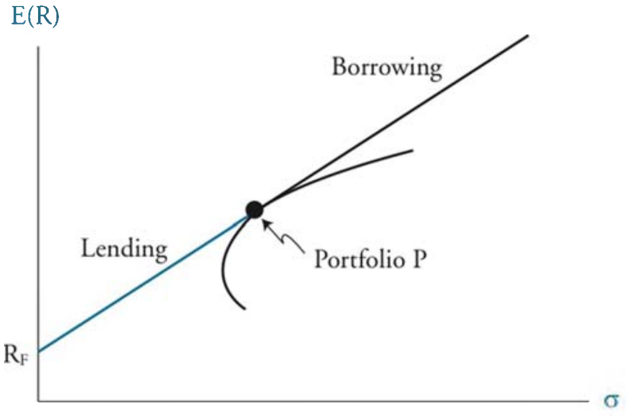
$$\sigma_C = w_P\sigma_P$$

Because the expected return and portfolio standard deviation of the combination of a risk-free asset and risky portfolio are both linear, the efficient frontier reduces to a linear equation. That is, by including the risk-free asset, we have caused the efficient frontier to become a straight line. The equation for the efficient frontier becomes the **capital market line (CML)**.

$$E(R_C) = R_F + \left(\frac{E(R_P) - R_F}{\sigma_P}\right)\sigma_C$$

Figure 10 illustrates the combination of the risk-free asset with the risky portfolio.

Figure 10: Efficient Frontier including the Risk-Free Asset



When the risk-free asset is combined with the risky Portfolio P, the efficient frontier becomes a line with:

- The intercept equal to the risk-free rate, and
- The slope equal to the reward-to-risk ratio for the risky portfolio.

Note that the capital market line is tangent to the efficient frontier. The point of tangency, Portfolio P, is known as the market portfolio. This portfolio contains all available risky assets in proportion to their total market values.

If all investors agree on the efficient frontier (i.e., they have homogeneous expectations regarding the risks and returns for all risky assets), they will hold a combination of the market portfolio and the risk-free asset. Risk-averse investors will create lower risk portfolios by lending (i.e., investing in the risk-free asset). More risk-tolerant investors will increase portfolio return by borrowing at the risk-free rate. This result is known as the separation theorem.

CONCEPT CHECKERS

1. Assume the following information for stocks A and B.
   - Expected return on Stock A = 18%.
   - Expected return on Stock B = 23%.
   - Correlation between returns of Stock A and Stock B = 0.10.
   - Standard deviation of returns on Stock A = 40%.
   - Standard deviation of returns on Stock B = 50%.

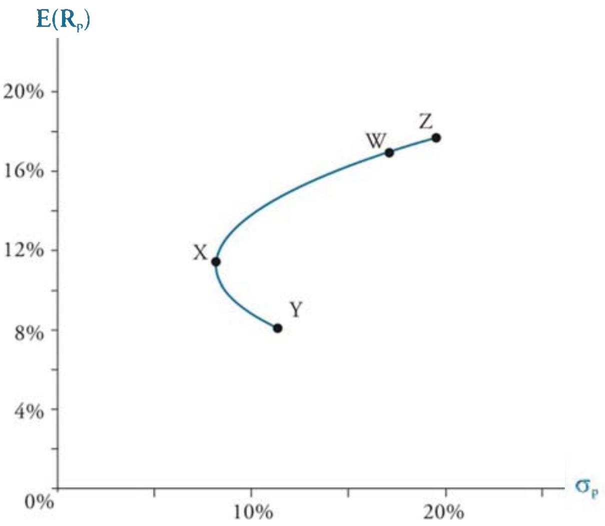
   The expected return and standard deviation of an equally weighted portfolio of stocks A and B are closest to:

	Expected return (%)	Standard deviation (%)
A.	20.5	33.54
B.	20.5	11.22
C.	33.5	11.22
D.	33.5	33.54

Use the following data to answer Questions 2 and 3.

Assume the expected return on stocks is 18% (represented by *Z* in the figure), and the expected return on bonds is 8% (represented by point *Y* on the graph).

Portfolio Possibilities Curve: Stocks and Bonds



2. The graph shows the portfolio possibilities curve for stocks and bonds. The point on the graph that most likely represents a 90% allocation in stocks and a 10% allocation in bonds is Portfolio:
   A. W.
   B. X.
   C. Y.
   D. Z.

3. The efficient frontier consists of the portfolios between and including:
   A. X and W.
   B. Y and Z.
   C. X and Z.
   D. Y and X.

4. Which of the following best describes the shape of the portfolio possibilities curve?
   A. The curve is strictly convex.
   B. The curve is strictly concave.
   C. The curve is concave above the minimum variance portfolio and convex below the minimum variance portfolio.
   D. The curve is convex above the minimum variance portfolio and concave below the minimum variance portfolio.

5. When short sales are possible (i.e., there are no short sale restrictions), the efficient frontier is:
   A. a straight line between the risk-free asset and the market portfolio.
   B. two line segments, which indicate a negative relationship between short and long positions.
   C. expanded to include portfolios with higher return and lower volatility.
   D. expanded to include portfolios with higher return and higher volatility.

CONCEPT CHECKER ANSWERS

1. **A** $E(R_p) = w_A E(R_A) + w_B E(R_B) = (0.50)(0.18) + (0.50)(0.23) = 0.205 = 20.5\%$

$$\sigma_p = \left[w_A^2\sigma_A^2 + w_B^2\sigma_B^2 + 2w_A w_B \rho_{AB}\sigma_A\sigma_B\right]^{1/2}$$

$$\sigma_p = \left[\begin{matrix}(0.5)^2(0.4)^2 + (0.5)^2(0.5)^2 \\ +2(0.5)(0.5)(0.1)(0.4)(0.5)\end{matrix}\right]^{1/2} = 0.3354 = 33.54\%$$

2. **A** Since the return to *W* is the nearest to *Z* (stocks), it is logical to assume that point *W* represents an allocation of 90% stocks/10% bonds. The return for *W* is lower than *Z*, but it also represents a reduction in risk.

3. **C** The *efficient frontier* consists of portfolios that have the maximum expected return for any given level of risk (standard deviation or variance). The efficient frontier starts at the global minimum-variance portfolio and continues above it. Any portfolio below the efficient frontier is dominated by a portfolio on the efficient frontier. This is because efficient portfolios have higher expected returns for the same level of risk.

4. **C** The portfolio possibilities curve is concave above the minimum variance portfolio and convex below the minimum variance portfolio.

5. **D** When short sales are allowed, the efficient frontier expands up and to the right (i.e., higher return and higher volatility portfolio combinations become feasible). When considering two stocks, by shorting the stock with lower expected return and using the proceeds to increase the investment in the other stock, it is possible to increase portfolio return. This increased return comes at a cost of higher volatility, though.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

THE STANDARD CAPITAL ASSET PRICING MODEL

Topic 10

EXAM FOCUS

This topic discusses the capital market line (CML) and the capital asset pricing model (CAPM). The CAPM requires many assumptions, such as the existence of a risk-free asset and that all investors have the same type of utility function and expectations. The existence of a risk-free asset means the efficient frontier becomes a straight line, which allows for the use of simple expressions to analyze price risk. It is important to have a firm grasp on the CAPM calculation methodology.

THE CAPITAL ASSET PRICING MODEL (CAPM)

LO 10.2: Describe the assumptions underlying the CAPM.

The **capital asset pricing model** (CAPM), derived by Sharpe, Lintner, and Mossin, is one of the most celebrated models in all of finance. The model describes the relationship we should expect to see between risk and return for individual assets. Specifically, the CAPM provides a way to calculate an asset's expected return (or "required" return) based on its level of systematic (or market-related) risk, as measured by the asset's beta.

CAPM Assumptions

In the derivation of any economic or scientific model, simplifying assumptions regarding the market, which the model represents, must be made. The CAPM has a number of underlying assumptions:

1. Investors face no transaction costs when trading assets. This assumption simplifies the computation of returns. If transaction costs were considered, returns would be a function of transaction costs, which would then have to be estimated.
2. Assets are infinitely divisible. It is possible to hold fractional shares.
3. There are no taxes; therefore, investors are indifferent between capital gains and income or dividends.
4. Investors are price takers whose individual buy and sell decisions have no effect on asset prices. The market for assets is perfectly competitive.
5. Investors' utility functions are based solely on expected portfolio return and risk. This assumption provides a framework for how investors make investment decisions.
6. Unlimited short-selling is allowed. Investors can sell an unlimited number of shares of an asset short.

7. Investors can borrow and lend unlimited amounts at the risk-free rate.
8. Investors are only concerned about returns and risk over a single period, and the single period is the same for all investors.
9. All investors have the same forecasts of expected returns, variances, and covariances. This is known as homogeneous expectations.
10. All assets are marketable, including human capital.

THE CAPITAL MARKET LINE (CML)

LO 10.3: Interpret the capital market line.

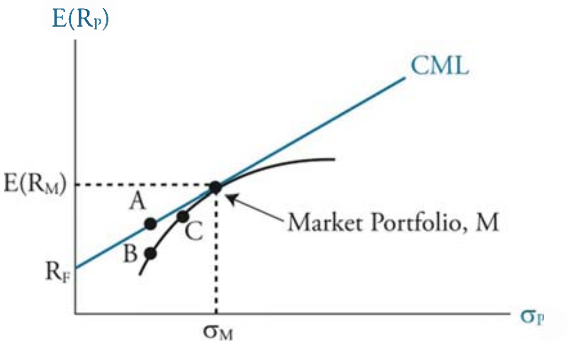
In the presence of riskless lending and borrowing, the efficient frontier transforms from a curve to a line tangent to the previous curve. Investors will choose to invest in some combination of their tangency portfolio and the risk-free asset. Assuming investors have identical expectations regarding expected returns, standard deviations, and correlations of all assets, there will be only one tangency line, which is referred to as the **capital market line** (CML).

Under the assumptions of the CML, all investors agree on the exact composition of the optimal risky portfolio. This universally agreed upon optimal risky portfolio is called the **market portfolio**, M, and it is defined as the portfolio of all marketable assets weighted in proportion to their relative market values. For instance, if the market value of Asset X is $1 billion, and the market value of all traded assets is $100 billion, then the weight allocated to Asset X in the market portfolio equals 1%.

The key conclusion of the CML can be summarized as follows: *All investors will make optimal investment decisions by allocating between the risk-free asset and the market portfolio.*

Figure 1 provides a graph of the CML.

Figure 1: The Capital Market Line



The equation for the CML is:

$$E(R_P) = R_F + \left[\frac{E(R_M) - R_F}{\sigma_M}\right]\sigma_P$$

The slope of the CML is often called the *market price of risk* and equals the reward-to-risk ratio (or Sharpe ratio) for the market portfolio. This is calculated as:

$$\frac{E(R_M) - R_F}{\sigma_M}$$

Professor's Note: We will examine the calculation of risk-adjusted return measures, such as the Sharpe ratio, in Topic 11.

The CML is useful for computing the expected return for an efficient (diversified) portfolio; however, it cannot compute the expected return for inefficient portfolios or individual securities. The CAPM must be used to compute the expected return for any inefficient portfolio or individual security.

BETA

LO 10.5: Interpret beta and calculate the beta of a single asset or portfolio.

The sensitivity of an asset's return to the market return is referred to as the asset's **beta**. Beta is a standardized measure of the covariance of the asset's return with the market return. Beta can be calculated as follows:

$$\beta_i = \frac{\text{covariance of Asset i's return with the market return}}{\text{variance of the market return}} = \frac{\mathrm{Cov}_{i,M}}{\sigma_M^2}$$

We can use the definition of the correlation between the returns on Asset *i* with the returns on the market to get the covariance equation:

$$\rho_{i,M} = \frac{\mathrm{Cov}_{i,M}}{\sigma_i \sigma_M}$$

$$\mathrm{Cov}_{i,M} = \rho_{i,M}\sigma_i\sigma_M$$

Therefore, by substituting for $\mathrm{Cov}_{i,M}$ in the equation for β_i, we can also calculate beta as:

$$\beta_i = \frac{\rho_{i,M}\sigma_i\sigma_M}{\sigma_M^2} = \rho_{i,M}\frac{\sigma_i}{\sigma_M}$$

Example: Calculating an asset's beta

The standard deviation of the market return is estimated as 20%.

1. If Asset A's standard deviation is 30% and its correlation of returns with the market index is 0.8, what is Asset A's beta?

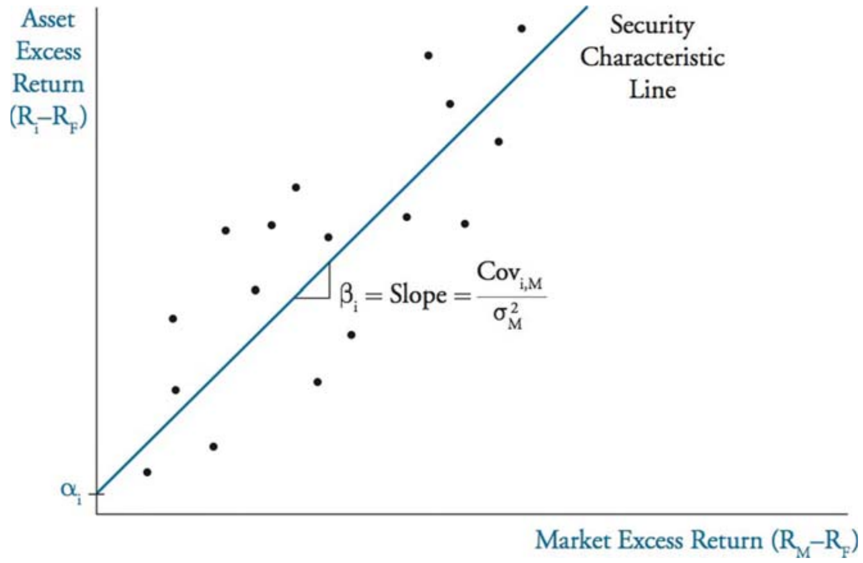
   Using the formula: $\beta_i = \rho_{i,M}\frac{\sigma_i}{\sigma_M}$, we have: $\beta_i = 0.80\frac{0.30}{0.20} = 1.2$.

2. If the covariance of Asset A's returns with the returns on the market index is 0.048, what is the beta of Asset A?

   Using the formula: $\beta_i = \frac{\text{Cov}_{i,M}}{\sigma_M^2}$, we have: $\beta_i = \frac{0.048}{0.2^2} = 1.2$.

In practice, we estimate asset betas by regressing returns on the asset on those of the market index. While regression is a concept discussed in Book 2, for the purposes of this topic, you can think of it as a mathematical estimation procedure that fits a line to a data plot. In Figure 2, we represent the excess returns on Asset *i* as the dependent variable and the excess returns on the market index as the independent variable. The *least squares regression line* is the line that minimizes the sum of the squared distances of the points plotted from the line (this is what is meant by the line of *best fit*). The slope of this line is our estimate of beta. In Figure 2, since the line is steeper than 45 degrees, the slope is greater than one, and the asset's estimated beta is greater than one. Our interpretation is that the returns on Asset *i* are more variable in response to systematic risk factors than the overall market, which has a beta of one.

Figure 2: Regression of Asset Excess Returns against Market Asset Returns



This regression line is referred to as the asset's security characteristic line. Mathematically, the slope of the security characteristic line is: $\text{Cov}_{i,M} / \sigma_M^2$, which is the same formula used to calculate beta.

Portfolio Beta

In addition to individual assets, beta can also be computed for portfolios. The beta of a portfolio is the sum of the weighted individual asset betas within a portfolio.

Example: Calculating portfolio beta

Consider the following individual asset weights and betas for a 4-asset portfolio.

Asset	*Portfolio Weight*	*Beta*
1	25%	1.2
2	15%	1.8
3	35%	0.9
4	25%	1.4

Calculate the beta of this 4-asset portfolio.

Answer:

$$\beta_P = w_1\beta_1 + w_2\beta_2 + w_3\beta_3 + w_4\beta_4$$

$$\beta_P = (0.25 \times 1.2) + (0.15 \times 1.8) + (0.35 \times 0.9) + (0.25 \times 1.4)$$

$$\beta_P = 0.3 + 0.27 + 0.315 + 0.35 = 1.235$$

DERIVING THE CAPM

LO 10.1: Understand the derivation and components of the CAPM.

A Straightforward Derivation

The procedure used to derive the equation for the capital asset pricing model requires an understanding of the characteristics of expected return, beta, the risk-free rate, and the security market line. The following steps illustrate how the CAPM is derived. The end result will be an equation where the expected return on a single security or portfolio of securities is equal to:

$$R_F + \text{Beta}_i[E(R_M) - R_F]$$

The first step in the derivation is to recognize that beta identifies the appropriate level of risk for which an investor should be compensated. An important concept in finance is that, as a portfolio becomes more diversified, idiosyncratic risk (i.e., unsystematic risk or asset-specific risk) in the portfolio becomes less of an issue as only systematic risk remains.

Professor's Note: Starting with the formula for portfolio variance, and assuming n equally-weighted assets (e.g., each w = 1/n), it is possible to show that the portfolio variance for an equally-weighted portfolio is:

$$\sigma_P^2 = \frac{1}{n}\overline{\sigma_i^2} + \frac{n-1}{n}\overline{Cov}$$

where:

$\overline{\sigma_i^2}$ = *average variance of all assets in the portfolio*

$\overline{Cov}$ = *average covariance of all pairings of assets in the portfolio*

Note that the equally-weighted portfolio variance equals the sum of two components (unsystematic risk: the variance term and systematic risk: the covariance term), each of which is affected by the size of the portfolio:

- $(1/n)\times\overline{\sigma_i^2}$ *gets closer to zero as n gets larger because 1/n approaches zero.*
- $[(n-1)/n]\times\overline{Cov}$ *gets closer to the average covariance as n gets larger because (n – 1) / n approaches 1.*

Therefore, the following important result emerges: The variance of an equally-weighted portfolio approaches the average covariance as n gets large.

Since diversification is costless and systematic risk is the only remaining risk in a diversified portfolio, an investor should only be compensated for systematic risk (or beta) exposure. Therefore, all assets with the same beta should earn the same return.

The next step in the derivation is to recognize that expected return is a linear function of beta. Since portfolio beta is the weighted average of the individual betas and expected portfolio return is a weighted average of the individual expected returns, the portfolio expected return is a linear function of beta.

$$E(R_P) = a + m \times \beta_P$$

where:

$\beta_P = \dfrac{Cov_{P,M}}{\sigma_M^2}$

$Cov_{P,M}$ = covariance between the returns for Stock P and the market portfolio

σ_M^2 = variance of the returns on the market portfolio

Professor's Note: To show that portfolio return is a linear function of beta, start with the functions for expected portfolio return and portfolio beta.

$$E(R_P) = w_1 E(R_1) + (1 - w_1) E(R_2)$$
$$\beta_P = w_1 \beta_1 + (1 - w_1) \beta_2$$

Solve w_1 *in the portfolio beta equation:*

$$w_1 = \frac{\beta_P - \beta_2}{\beta_1 - \beta_2}$$

Substitute w_1 *into the portfolio expected return equation:*

$$E(R_P) = \frac{\beta_P - \beta_2}{\beta_1 - \beta_2} E(R_1) + \left(1 - \frac{\beta_P - \beta_2}{\beta_1 - \beta_2}\right) E(R_2)$$
$$E(R_P) = \left[E(R_2) - \frac{\beta_2 [E(R_1) - E(R_2)]}{\beta_1 - \beta_2}\right] + \beta_P \frac{[E(R_1) - E(R_2)]}{\beta_1 - \beta_2}$$
$$E(R_P) = a + m\beta_P$$

where:

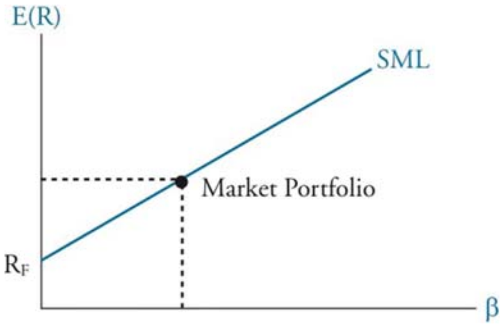
$$a = E(R_2) - \frac{\beta_2 [E(R_1) - E(R_2)]}{\beta_1 - \beta_2}$$
$$m = \frac{[E(R_1) - E(R_2)]}{\beta_1 - \beta_2}$$

Assets with equivalent betas should earn the same return because arbitrage will prevent assets with the same risk from earning different returns. So, if $\beta_i = \beta_P$ and $E(R_i) = E(R_P)$, then we can express the expected return for asset i as a linear function of its beta:

$$E(R_i) = a + m \times \beta_i$$

As shown in Figure 3, this equation plots a straight line, known as the security market line (SML) with an intercept of *a* and slope of *m*. Thus, the SML is a graphical representation of the CAPM.

Figure 3: The Security Market Line



The final step in this derivation is to find two points on the SML and solve for the CAPM. To solve for the equation of a line (which is known as identifying the line), we need to know two points on the line. Fortunately, we do know two of the points on this line: the risk-free asset and the market portfolio. Since it has no risk, the risk-free asset has a beta of zero; therefore, the intercept of the SML is R_F, and our first point is $(0, R_F)$. The market portfolio has a beta of one, so the second point is $[1, E(R_M)]$. With these two points, we can find the slope of the line, *m*:

$$E(R_i) = a + m \times \beta_i$$

$$E(R_M) = R_F + m \times 1$$

$$m = E(R_M) - R_F$$

Professor's Note: It is relatively straightforward to see that the beta of the market is one. The covariance of the market with itself is equal to the variance of the market. Therefore, solving for market beta, we get:

$$\beta_M = \frac{Cov_{M,M}}{\sigma_M^2} = \frac{\sigma_M^2}{\sigma_M^2} = 1$$

With information on both the intercept (a) and the slope (m), we are now able to display the well-known capital asset pricing model:

$$E(R_i) = R_F + [E(R_M) - R_F]\beta_i$$

CALCULATING EXPECTED RETURN USING THE CAPM

LO 10.4: Apply the CAPM in calculating the expected return on an asset.

Example: Expected return on a stock

Assume you are assigned the task of evaluating the stock of Sky-Air, Inc. To evaluate the stock, you calculate its required return using the CAPM. The following information is available:

expected market risk premium	5%
risk-free rate	4%
Sky-Air beta	1.5

Using CAPM, **calculate** and **interpret** the expected return for Sky-Air.

Answer:

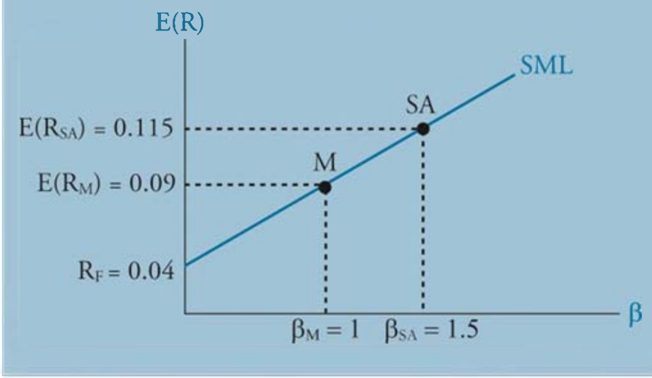
The expected return for Sky-Air is:

$$E(R_{SA}) = 0.04 + 1.5(0.05) = 0.115 = 11.5\%$$

The market risk premium is the expected market return minus the risk-free rate. The CAPM return can be viewed as the minimum return that investors should be willing to accept (i.e., the required rate of return), commensurate with the risk associated with the asset. For example, if investors predict that the return will exceed 11.5%, then they should buy Sky-Air stock. However, if investors predict that the return will be less than 11.5%, then they should sell Sky-Air stock (or short the stock).

Figure 4 illustrates the required return for Sky-Air on the SML.

Figure 4: Sky-Air Plotted on the Security Market Line



In the previous example, we calculated the required rate of return, which always lies on the security market line. If through the valuation of an asset an analyst determines that the expected return is different from the required rate of return implied by CAPM, then the security may be mispriced according to rational expectations. A mispriced security would not lie on the security market line. In general:

- An overvalued security would have a required rate of return (computed by CAPM) that is higher than its expected return (computed by the analyst's valuation). An overvalued security would lie below the security market line.
- An undervalued security would have a required rate of return (computed by CAPM) that is lower than its expected return (computed by the analyst's valuation). An undervalued security would lie above the security market line.

In addition to computing the required or expected return for an individual asset, it is possible to solve for the expected return on the market and/or the market risk premium given the risk-free rate, expected return on an asset, and the systematic risk for that asset.

Example: Using CAPM to calculate the expected market return

A stock has a beta of 0.75 and an expected return of 13%. The risk-free rate is 4%. **Calculate** the market risk premium and the expected return on the market portfolio.

Answer:

According to CAPM: $0.13 = 0.04 + 0.75[E(R_M) - R_F]$.

Therefore, the market risk premium is equal to: $[E(R_M) - R_F] = 0.12 = 12\%$.

The expected return on the market is calculated as: $[E(R_M) - 0.04] = 0.12$, or $E(R_M) = 0.16 = 16\%$.

KEY CONCEPTS

LO 10.1

There are three major steps in deriving the CAPM:

1. Recognize that since investors are only compensated for bearing systematic risk, beta is the appropriate measure of risk.

2. By knowing that portfolio expected return is a weighted average of individual expected returns and portfolio beta is a weighted average of the individual betas, we can show that portfolio return is a linear function of portfolio beta. Since arbitrage prevents mispricing of assets relative to systematic risk (beta), an individual asset's expected return is a linear function of its beta.

3. Use the risk-free asset and the market portfolio, which are two points on the security market line, to solve for the intercept and slope of the CAPM. The equation for CAPM is:

$$E(R_i) = R_F + [E(R_M) - R_F]\beta_i$$

LO 10.2

The capital asset pricing model (CAPM), derived by Sharpe, Lintner, and Mossin, expresses the expected return for an asset as a function of the asset's level of systematic risk (measured by beta), the risk-free rate, and the market risk premium (the expected return of the market minus the risk-free rate). There are several assumptions underlying the CAPM.

- Investors face no transaction costs.
- Assets are infinitely divisible.
- There are no taxes.
- Investors are price takers whose individual buy and sell decisions have no effect on asset prices.
- Investors' utility functions are based solely on expected portfolio return and risk.
- Unlimited short-selling is allowed.
- Investors are only concerned about returns and risk over a single period, and the single period is the same for all investors.
- All investors have the same forecasts of expected returns, variances, and covariances.
- All assets are marketable.

LO 10.3

The capital market line (CML) expresses the expected return of a portfolio as a linear function of its standard deviation, the market portfolio's return and standard deviation, and the risk-free rate.

$$E(R_C) = R_F + \left[\frac{E(R_M) - R_F}{\sigma_M}\right]\sigma_C$$

LO 10.4

The expected return for an asset can be computed using the CAPM given the risk-free rate, the market risk premium, and an asset's systematic risk.

LO 10.5

Beta can be calculated using the following equation:

$$\beta_i = \frac{\text{Cov}_{i,M}}{\sigma_M^2}$$

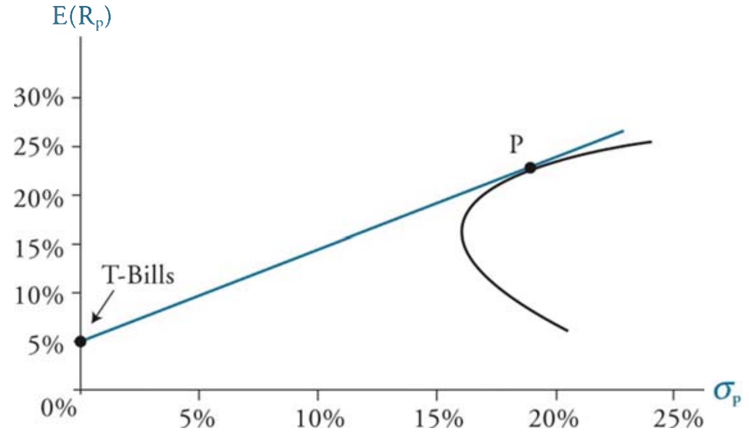
Portfolio beta is the weighted average of the asset betas in a portfolio.

CONCEPT CHECKERS

1. Which of the following statements is most likely an assumption of the capital asset pricing model (CAPM)?
   A. Investors only face capital gains taxes.
   B. Investors' actions affect the prices of assets.
   C. Transaction costs are constant across all assets.
   D. All assets including human capital are marketable.

Use the following graph to answer Question 2.

Mean-Variance Analysis



2. Portfolio P in the mean variance analysis represents the tangency point between the capital market line and the portfolio possibilities curve. In this analysis, the market price of risk would be the:
   A. standard deviation of Portfolio P.
   B. expected return on the minimum-variance portfolio.
   C. slope of the line connecting T-bills and Portfolio P.
   D. point at which the straight line intersects the expected return axis.

3. At a recent analyst meeting at Invest Forum, analysts Michelle White and Ted Jones discussed the use of the capital market line (CML). White states that the CML assumes that investors hold two portfolios: 1) a risky portfolio of all assets weighted according to their relative market value capitalizations; and 2) the risk-free asset. Jones states that the CML is useful in determining the required rate of return for individual securities.

   Are the statements of White and Jones correct?
   A. Only Jones's statement is correct.
   B. Only White's statement is correct.
   C. Both statements are correct.
   D. Neither statement is correct.

4. Patricia Franklin makes buy and sell stock recommendations using the capital asset pricing model. Franklin has derived the following information for the broad market and for the stock of the CostSave Company (CS):

• Expected market risk premium	8%
• Risk-free rate	5%
• Historical beta for CostSave	1.50

Franklin believes that historical betas do not provide good forecasts of future beta, and therefore uses the following formula to forecast beta:

forecasted beta = 0.80 + 0.20 × historical beta

After conducting a thorough examination of market trends and the CS financial statements, Franklin predicts that the CS return will equal 10%. Franklin should derive the following required return for CS along with the following valuation decision (undervalued or overvalued):

	Valuation	CAPM required return
A.	overvalued	8.3%
B.	overvalued	13.8%
C.	undervalued	8.3%
D.	undervalued	13.8%

5. Albert Dreiden wants to estimate the expected return on the market. He believes that the stock of the Hobart Materials Company is fairly valued, and gathers the following information:

• Expected return for Hobart	7.50%
• Risk-free rate	4.50%
• Beta for Hobart	0.80

Based on this information, the estimated expected return for the market portfolio is closest to:

A. 3.00%.
B. 3.75%.
C. 6.90%.
D. 8.25%.

CONCEPT CHECKER ANSWERS

1. **D** The capital asset pricing model (CAPM) assumes that all assets including human capital are marketable. Additionally, CAPM assumes no taxes, no transaction costs, and that investor actions do not affect market prices.

2. **C** The CML is the line connecting T-bills and Portfolio P. The market price of risk is the slope of the CML. Had risk been measured on the graph with beta, the graph would represent the SML. The market price of risk would still be the slope of the line.

3. **B** The CML assumes all investors have identical expectations and all use mean-variance analysis, implying that they all identify the same risky tangency portfolio (the "market portfolio") and combine that risky portfolio with the risk-free asset when creating their portfolios. Because all investors hold the same risky portfolio, the weight on each asset must be equal to the proportion of its market value to the market value of the entire portfolio. Therefore, White is correct. The CML is useful for determining the rate of return for efficient portfolios, but it cannot be used to determine the required rate of return for inefficient portfolios or individual securities. The capital asset pricing model (CAPM) is used to determine the required rate of return for inefficient portfolios and individual securities. Therefore, Jones is incorrect.

4. **B** The CAPM equation is:

   $E(R_i) = R_F + \beta_i[E(R_M - R_F)]$

   Franklin forecasts the beta for CostSave as follows:

   beta forecast = 0.80 + 0.20 (historical beta)

   beta forecast = 0.80 + 0.20(1.50) = 1.10

   The CAPM required return for CostSave is:

   0.05 + 1.1(0.08) = 13.8%

   Note that the market premium, $E(R_M) - R_F$, is provided in the question (8%).

   Franklin should decide that the stock is overvalued because she forecasts that the CostSave return will equal only 10%, whereas the required return (minimum acceptable return) is 13.8%.

5. **D** The CAPM equation is:

   $E(R_i) = R_F + \beta_i[E(R_M - R_F)]$

   Using the given information, we can solve for the expected return for the market portfolio as follows:

   $7.50\% = 4.50\% + 0.80[E(R_M) - 4.50\%]$

   $E(R_M) = (7.50\% - 4.50\%) / 0.80 + 4.50\% = 8.25\%$

   Based on the information given and using the CAPM, the expected return on the market is 8.25%.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

APPLYING THE CAPM TO PERFORMANCE MEASUREMENT: SINGLE-INDEX PERFORMANCE MEASUREMENT INDICATORS

Topic 11

EXAM FOCUS

This topic further expands on the concepts of the capital market line and the security market line by examining measures used to assess portfolio performance on a risk-adjusted basis. In the previous topic, we mentioned that the risk-to-reward ratio for the capital market line (i.e., its slope) is known as the Sharpe ratio. In addition, we discussed how to assess a portfolio's alpha return when comparing actual performance to expected performance based on the CAPM. The formal expression for this calculation is known as Jensen's alpha. The Treynor measure is another popular performance metric, and is similar to the Sharpe ratio but uses beta as the risk measure instead of standard deviation. Toward the end of this topic, we examine additional risk-return assessment measures such as the information ratio and the Sortino ratio. In general, all of the performance measures introduced evaluate excess return over some form of risk. For the exam, memorize these measures of performance since they are popular concepts to test.

MEASURES OF PERFORMANCE

LO 11.1: Calculate, compare, and evaluate the Treynor measure, the Sharpe measure, and Jensen's alpha.

Modern portfolio theory and the CAPM are built upon the link between risk and return. Three measures exist to assess an asset's or portfolio's return with respect to its risk.

- The **Treynor measure** is equal to the risk premium divided by beta, or systematic risk:

$$\text{Treynor measure of a portfolio} = \left[\frac{E(R_P) - R_F}{\beta_P}\right]$$

- The **Sharpe measure** is equal to the risk premium divided by the standard deviation, or total risk:

$$\text{Sharpe measure of a portfolio} = \left[\frac{E(R_P) - R_F}{\sigma_P}\right]$$

- The **Jensen measure** (or Jensen's alpha or just **alpha**), is the asset's excess return over the return predicted by the CAPM:

$$\text{Jensen measure of a portfolio} = \alpha_P = E(R_P) - [R_F + [E(R_M) - R_F]\beta_P]$$

In all three cases, for a given portfolio, the higher, the better. The two that are most similar are the Treynor and Sharpe measures. They both normalize the risk premium by dividing by a measure of risk. Investors can apply the Sharpe measure to all portfolios because it uses total risk, and it is more widely used than the other two measures. The Treynor measure is more appropriate for comparing well-diversified portfolios. Jensen's alpha is the most appropriate for comparing portfolios that have the same beta.

Some consider the Sharpe measure a better method for measuring historical performance. Since betas must be estimated and the portfolio beta is the weighted average of the betas of assets in a portfolio, the Treynor measure is considered a more forward-looking measure.

In addition to these comparisons, it is useful to realize that some relationships exist between the measures. For instance:

$$\text{Treynor measure} = \frac{\alpha_P}{\beta_P} + [E(R_M) - R_F]$$

For a well-diversified portfolio we can use the following approximation: $\beta_P \approx \frac{\sigma_P}{\sigma_M}$.

Substituting this into the expression for Jensen's alpha and applying some algebra gives us:

$$\text{Sharpe measure} \approx \frac{\alpha_P}{\sigma_P} + \frac{E(R_M) - R_F}{\sigma_M}$$

Applying the approximation $\beta_P \approx \frac{\sigma_P}{\sigma_M}$ again gives us:

$$\text{Sharpe measure} \approx \left[\frac{\text{Treynor measure}}{\sigma_M}\right]$$

Professor's Note: Do not focus too much attention on these approximations. The key is understanding how to calculate the three measures of performance as is shown in the following example.

Example: Calculating performance measures

For a portfolio of ten stocks, we may find, via fundamental analysis estimates of the individual stocks, that the portfolio's expected return is 14% with a standard deviation of 25%. The beta of the portfolio is 1.1. The expected return of the market is 12.5% with a standard deviation of 20.2%. The risk-free rate is 2.6%. **Calculate** the Treynor, Sharpe, and Jensen measures.

Answer:

$$\text{Treynor measure} = \left[\frac{E(R_P) - R_F}{\beta_P}\right] = \left[\frac{0.14 - 0.026}{1.1}\right] = 0.1036$$

$$\text{Sharpe measure} = \left[\frac{E(R_P) - R_F}{\sigma_P}\right] = \left[\frac{0.14 - 0.026}{0.25}\right] = 0.456$$

$$\text{Jensen measure} = \alpha_P = E(R_P) - \left[R_F + [E(R_M) - R_F]\beta_P\right]$$

$$= 0.14 - [0.026 + (0.125 - 0.026)(1.1)] = 0.0051$$

We can compare these to the corresponding measures of the market portfolio:

$$\text{Treynor measure of the market} = \left[\frac{0.125 - 0.026}{1}\right] = 0.099$$

$$\text{Sharpe measure of the market} = \left[\frac{0.125 - 0.026}{0.202}\right] = 0.4901$$

$$\text{Jensen measure of a portfolio} = 0.125 - [0.026 + (0.125 - 0.026)(1)] = 0.0$$

Based upon the Treynor measure and the Jensen measure of the preceding example, the portfolio of ten stocks is superior to the market. However, the relationship is reversed using the Sharpe measure. This implies that the manager has selected ten stocks that offer superior returns relative to their systematic risk; however, a 10-stock portfolio is much less diversified than the market. The standard deviation for the 10-stock portfolio ($\sigma_P = 25\%$), when compared to $\sigma_M = 20.2\%$, reflects the lower level of diversification.

Extensions to Jensen's Alpha

There are several ways to modify or extend the Jensen measure. Since Jensen's measure is simply a raw return in excess of some reference (i.e., that implied by the CAPM in the case of the standard Jensen's measure) we can simply replace that reference with a value that we feel is more appropriate. One reference would be the required return based on the CML. The manager has created a portfolio with risk σ_P, which then has a reference return equal to $E(R_{\text{reference}})$ as given by the equation:

$$E(R_{\text{reference}}) = R_F + [E(R_M) - R_F]\left[\frac{\sigma_P}{\sigma_M}\right]$$

The alpha in this case would be the portfolio's return minus the reference return:

$$\text{alpha} = E(R_P) - E(R_{\text{reference}})$$

Other extensions of Jensen's measure would use a measure of $E(R_{\text{reference}})$ derived from a multifactor model (i.e., more than one independent variable). Another value of $E(R_{\text{reference}})$ could be derived from a variation of the CAPM called the Black model, which uses the return on a "zero-beta" portfolio in place of the risk-free rate. In all cases, the idea is the same: measure the raw return difference of the managed portfolio against the required return given its level of risk.

LO 11.2: Compute and interpret tracking error, the information ratio, and the Sortino ratio.

If a manager is trying to earn a return higher than the market portfolio or any other reference or benchmark, the difference will have some variability over time. In other words, even if the manager is successful in generating a positive alpha, the alpha will vary over time. **Tracking error** is the term used to describe the standard deviation of the difference between the portfolio return and the benchmark return. This source of variability is another source of risk to use in assessing the manager's success. Typically, the manager must keep the tracking error below a stated threshold. The manager must weigh transactions and other costs in managing the portfolio to reduce tracking error against the extra risk it introduces into the management process.

The **information ratio** is essentially the alpha of the managed portfolio relative to its benchmark divided by the tracking error. If we let R_B denote the return of the benchmark we can write:

$$e_P = R_P - R_B$$

$$\text{tracking error} = \sigma_{eP}$$

$$\text{information ratio} = \left[\frac{E(R_P) - E(R_B)}{\sigma_{eP}}\right] = \frac{\alpha_P}{\sigma_{eP}}$$

This is a measure used to assess if the manager's deviation from the benchmark has reaped an appropriate return. It is called an "information ratio" because it is essentially a measure of how well the manager has acquired and used information compared to the average manager.

Example: Calculating the information ratio

A manager typically generates an alpha of 1.5% with a tracking error of 2.25%. **Calculate** the information ratio.

Answer:

$$\text{information ratio} = \left[\frac{1.5}{2.25}\right] = 0.667$$

The **Sortino ratio** is similar to the Sharpe ratio except for two changes. We replace the risk-free rate with a minimum acceptable return, denoted R_{min}, and we replace the standard deviation with a type of semi-standard deviation. A semi-standard deviation measures the variability of only those returns that fall below the minimum acceptable return. The measure of risk in the Sortino ratio is the square root of the mean squared deviation from R_{min} of those observations in time periods t where $R_{Pt} < R_{min}$, else zero. Letting R_{min} denote the minimal acceptable return and MSD_{min} the risk measure:

$$\text{Sortino ratio} = \frac{E(R_P) - R_{min}}{\sqrt{MSD_{min}}}$$

where:

$$MSD_{min} = \frac{\sum_{R_{Pt}<R_{min}} (R_{Pt} - R_{min})^2}{N}$$

The Sortino ratio can be interpreted as a variation of the Sharpe ratio that is more appropriate for a case where returns are not symmetric.

Example: Calculating the information ratio and the Sortino ratio

Over a 10-year period, a manager uses a covered call strategy to enhance the return of the index fund she manages. The record of the fund's returns is (0.095, 0.08, –0.022, 0.11, 0.09, –0.05, –0.035, 0.124, 0.072, 0.055). The corresponding benchmark returns record is (0.087, 0.078, –0.034, 0.124, 0.10, –0.064, –0.042, 0.131, 0.062, 0.059). The minimum acceptable return is 4%. **Calculate** the information ratio and the Sortino ratio. Assume tracking error = 0.00992 and mean squared deviation (min) = 0.0017569.

Answer:

If we were to compute the tracking error, the first step would be to compute the differences between the portfolio and the benchmark. Those differences are: (0.008, 0.002, 0.012, –0.014, –0.01, 0.014, 0.007, –0.007, 0.01, –0.004). The tracking error is the standard deviation of these numbers.

Professor's Note: In Book 2, we will examine the formula for standard deviation that is used for the tracking error calculation. It is based on the sum of the squared differences between each data point and the mean. This sum is divided by the number of observations adjusted for degrees of freedom (in this case n – 1). The square root of the computed value will be the standard deviation.

To compute the information ratio, divide the mean of the differences by the tracking error.

information ratio = 0.0018 / 0.00992 = 0.1815

The Sortino ratio is the mean of the ten portfolio returns minus 4%, which is 0.0519 – 0.04 = 0.0119, divided by the square root of MSD_{min}.

$MSD_{min} = 0.0017569$

Sortino ratio = 0.0119 / 0.0419 = 0.2840

KEY CONCEPTS

LO 11.1

Three commonly used risk/return measures are:

- Treynor measure of a portfolio = $\left[\frac{E(R_P) - R_F}{\beta_P}\right]$
- Sharpe measure of a portfolio = $\left[\frac{E(R_P) - R_F}{\sigma_P}\right]$
- Jensen measure of a portfolio = $\alpha_P = E(R_P) - [R_F + [E(R_M) - R_F]\beta_P]$

The three risk measures above give different perspectives and may give different rankings for portfolios. A portfolio with low diversification may have a higher Treynor measure, a higher alpha, but a lower Sharpe measure than another portfolio.

Alpha can be modified by the use of other reference portfolios.

LO 11.2

Tracking error and the information ratio build upon Jensen's alpha. Tracking error is the standard deviation of alpha over time. The information ratio is the average alpha over time divided by the tracking error.

The Sortino ratio should be used when there is more focus on the likelihood of loss:

$$\text{Sortino ratio} = \frac{E(R_P) - R_{min}}{\sqrt{MSD_{min}}}$$

The MSD_{min} is a semi-variance that only measures the variability of the portfolio's return observations below R_{min}.

CONCEPT CHECKERS

1. For a given portfolio, having a Treynor measure greater than the market but a Sharpe measure that is less than the market would most likely indicate that the portfolio is:
   A. not well diversified.
   B. generating a negative alpha.
   C. borrowing at the risk-free rate.
   D. not borrowing at the risk-free rate.

2. With respect to performance measures, the use of the standard deviation of portfolio returns is a distinguishing feature of the:
   A. beta measure.
   B. Jensen measure.
   C. Sharpe measure.
   D. Treynor measure.

3. For a given portfolio, the expected return is 9% with a standard deviation of 16%. The beta of the portfolio is 0.8. The expected return of the market is 12% with a standard deviation of 20%. The risk-free rate is 3%. The portfolio's alpha is:
   A. –1.2%.
   B. –0.6%.
   C. +0.6%.
   D. +1.2%.

4. You are given the following information:

Risk-free rate	4%
Minimum acceptable return	6%
Benchmark return	10%
Expected return on portfolio	12%
Expected return on market	9%
Beta	1.25
Standard deviation (portfolio)	7.3%
Semi-standard deviation (portfolio)	8.2%

   The Sortino ratio of the portfolio is closest to:
   A. 0.24.
   B. 0.73.
   C. 0.82.
   D. 0.98.

5. An analyst has compiled the following data on Stock P:

$\text{Covariance}_{\text{P, market}}$	0.0315
$\sigma_{\text{Stock P}}$	16.50%
σ_{market}	15.00%
Expected market return	11.80%
Risk-free rate	4.50%
Stock P actual return	13.25%

Calculate and interpret Jensen's Alpha for Stock P.

A. +1.47% overperformed.
B. –1.47% underperformed.
C. +1.45% overperformed.
D. –1.45% underperformed.

CONCEPT CHECKER ANSWERS

1. **A** Low diversification can produce this result because it will likely increase the standard deviation of the portfolio's returns, thus decreasing its Sharpe ratio. Using margin is not directly related to the risk-adjusted performance because adjusting for risk removes the effect of leverage. A Treynor ratio greater than the market Treynor ratio would result in a positive alpha (not a negative alpha).

2. **C** The Sharpe measure is the portfolio return minus the risk-free rate divided by the standard deviation of the return. The Treynor and Jensen measures use beta. The answer "beta measure" is a nonsensical choice for this question.

3. **A** The alpha is 9% – [3% + 0.8 × (12% – 3%)] = –1.2%.

4. **B** (portfolio return – minimum acceptable return) / semi-standard deviation

   (0.12 – 0.06) / 0.082 = 0.7317

   Choice A is incorrect because it uses the benchmark return in the numerator instead of the minimum acceptable return.

   Choice C is incorrect because it uses the standard deviation in the denominator instead of the semi-standard deviation.

   Choice D is incorrect because it uses the risk-free rate in the numerator instead of the minimum acceptable return.

5. **B** Jensen's Alpha = actual return – CAPM expected return

   CAPM: $E(R) = R_F + \beta(R_M - R_F)$

   $$\beta = \frac{\text{covariance}_{P,\,\text{market}}}{\text{variance}_{\text{market}}}$$

   Step 1: Calculate β

   $\beta = 0.0315 / 0.15^2$ $\quad\quad$ $\beta = 1.4$

   Step 2: Calculate the CAPM expected return

   E(R) = 4.5 + 1.4(11.80 – 4.5) = 14.72%

   Step 3: Calculate Jensen's Alpha

   Jensen's Alpha = actual return – CAPM E(R) = 13.25% – 14.72% = –1.47%

   Stock P has underperformed the market by 1.47% when taking into account its level of systematic risk as measured by beta.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

ARBITRAGE PRICING THEORY AND MULTIFACTOR MODELS OF RISK AND RETURN

Topic 12

EXAM FOCUS

The relationship between risk and return is one of the most important concepts in finance. The capital asset pricing model (CAPM) asserts that the expected return on any asset is solely determined by its exposure to the market portfolio. The risk exposure in the CAPM is known as beta. In contrast, the arbitrage pricing theory (APT) asserts that expected returns are determined by exposures to economy-wide risk factors. The risk exposures in the APT are known as factor betas. For the exam, be able to calculate expected returns using single-factor and multifactor models. In addition, know how to construct the security market line (SML) for a well-diversified portfolio using a single-factor model. Also, be able to explain the APT, and know how to construct a portfolio to hedge exposure to multiple risk factors.

THE MULTIFACTOR MODEL OF RISK AND RETURN

LO 12.1: Describe the inputs, including factor betas, to a multifactor model.

The inputs to a **multifactor model**, for any stock, are as follows:

- Expected return for the stock.
- Factor betas, also known as factor sensitivities or factor loadings.
- Deviation of macroeconomic factors from their expected values.
- Firm-specific return.

The equation for a multifactor model for stock *i* can be expressed as follows:

$$R_i = E(R_i) + \beta_{i1}F_1 + \beta_{i2}F_2 + \ldots + \beta_{ik}F_k + e_i$$

where:
R_i = return on stock *i*
$E(R_i)$ = expected return for stock *i*
β_{ij} = j^{th} factor beta for stock *i*
F_j = deviation of macroeconomic factor *j* from its expected value
e_i = firm-specific return for stock *i*

Regarding macroeconomic factors, assume that one of the macro factors is gross domestic product (GDP). In this case, F_{GDP} will represent the deviation of GDP from its expected value. If we assume that the consensus forecast for GDP equals 3%, and GDP for the period ended up being 4%, F_{GDP} would equal 0.01 (0.04 – 0.03 = 0.01).

The **factor beta**, β_{ij}, equals the sensitivity of the stock return to a 1-unit change in the factor. For example, for stock *i*, assume $\beta_{i,GDP} = 2$. Therefore, for every one percentage point change in GDP, this stock's return changes, on average, by two percentage points.

The **firm-specific return**, e_i, is the portion of the stock's return that is unexplained by macro factors (i.e., the F terms in the equation). The firm-specific return will be a nonzero value whenever unexpected firm-specific events take place (e.g., a strike that impacts a single firm). However, the expected value of the firm-specific return equals zero, because, by definition, firm-specific events are random.

Professor's Note: For the moment, we will assume that the expected return, $E(R_i)$, is known. Later, we will use the arbitrage pricing theory to derive the expected return. In that case, the factor betas will be estimated as the slope coefficients in a multiple linear regression.

LO 12.2: Calculate the expected return of an asset using a single-factor and a multifactor model.

The factor model just described can be used to revise the estimate of a stock's expected rate of return. The number of factors to include in a factor model should be as small as possible, yet still capture the priced sources of nondiversifiable (or *systematic*) risk. The simplest version of the model consists of just one macro factor: the **single-factor model**. We will consider examples of a single-factor model first, and, then, will consider a 2-factor model.

For the first example, assume the common stock of HealthCare Inc. (HCI) is examined with a single-factor model, using unexpected percent changes in GDP as the single factor. Assume the following data is provided:

Expected return for HCI = 10%
GDP factor beta = 2.00
Expected GDP growth = 3%

Given this data, we can see that the stock return for HCI is strongly impacted by GDP. On average, the stock price changes by two percentage points for every one percentage point change in GDP.

Suppose new macroeconomic information indicates that GDP growth will equal 4% rather than the original consensus forecast of 3%. Also assume there's no new information regarding firm-specific events. The revised expected return for HCI using a single-factor model can be calculated as follows:

$$R_{HCI} = E(R_{HCI}) + \beta_{HCI,GDP}F_{GDP} + e_{HCI}$$

$$R_{HCI} = 0.10 + 2(0.01) = 0.12 = 12\%$$

Therefore, based on the single-factor model, the analyst should revise the expected return for HCI from 10% to 12%, because GDP was revised above its original expected value. The additional two percentage points resulted from the one percentage point deviation of GDP from its expected value, combined with the GDP factor beta of 2: 2 × 0.01 = 0.02 = 2%.

For the second example, assume the common stock of HealthCare Inc. (HCI) is examined using a multifactor model, based on two factors: unexpected percent changes in GDP and unexpected percent changes in consumer sentiment. Assume the following data is provided:

Expected return for HCI	= 10%
GDP factor beta	= 2.00
Consumer sentiment (CS) factor beta	= 1.50
Expected growth in GDP	= 3%
Expected growth in consumer sentiment	= 1%

Suppose new macroeconomic information indicates that GDP will grow 4% rather than 3%, and that consumer sentiment will grow 3% rather than 1%. A 2-factor model to calculate the return for HCI can be expressed as follows:

$$R_{HCI} = E(R_{HCI}) + \beta_{HCI,GDP}F_{GDP} + \beta_{HCI,CS}F_{CS} + e_{HCI}$$

$$R_{HCI} = 0.10 + 2(0.01) + 1.5(0.02) = 0.15 = 15\%$$

Therefore, based on this multifactor model, the revised estimate of the expected return for HCI equals 15%, which is five percentage points higher than initially expected. The sources of the revised return are the macroeconomic revisions to GDP and consumer sentiment.

THE LAW OF ONE PRICE AND ARBITRAGE OPPORTUNITIES

According to the **Law of One Price**, identical assets selling in different locations should be priced identically in the different locations. For example, assume the common stock of GH Inc. is listed on both the NYSE and NASDAQ. According to the Law of One Price, there should be no difference in the stock prices of GH's transactions on the NYSE versus NASDAQ. If there were different prices available, an arbitrage opportunity would exist. For example, assume the stock price for GH on the NYSE is $60, and assume the stock price for GH on NASDAQ is $58. In this case, investors could buy GH's stock on NASDAQ for $58 and simultaneously sell the stock for $60 on the NYSE. These actions would continue until the stock prices are identical on the two exchanges.

The action of buying an asset in the cheaper market and simultaneously selling that asset in the more expensive market is called **arbitrage**. The actions of arbitrageurs cause prices to rise in the cheaper market and fall in the expensive market. The simultaneous trades will continue until the asset trades at one price in both markets, at which point the arbitrage opportunity will be fully exploited.

The Law of One Price can be extended to different assets that have identical risks. The following example illustrates whether an arbitrage situation exists using a multifactor model. Assume a 2-factor model is used to examine the returns for two assets, A and B. Also, assume the two factors are unexpected percentage changes in GDP and consumer sentiment (CS).

$$R_A = E(R_A) + \beta_{A,GDP}F_{GDP} + \beta_{A,CS}F_{CS} + e_A$$

$$R_B = E(R_B) + \beta_{B,GDP}F_{GDP} + \beta_{B,CS}F_{CS} + e_B$$

Additional data:

$E(R_A) = 0.12$
$E(R_B) = 0.10$
$\beta_{A,GDP} = \beta_{B,GDP} = 2$
$\beta_{A,CS} = \beta_{B,CS} = 1.5$

Notice that the factor betas are identical for Asset A and Asset B. Therefore, the systematic risks are identical between these assets. If the systematic risks of two assets are identical, then the expected returns for the two assets should also be identical.

In this example, an arbitrage opportunity exists because the assets are priced based on different expected returns even though the systematic risks of the two assets are identical. An investor can exploit the arbitrage opportunity by shorting Asset B and using the proceeds from the short position to take a long position in Asset A. The expected return and factor betas for the long-short hedge portfolio, H, are calculated as follows:

$E(R_H) = E(R_A) - E(R_B) = 0.12 - 0.10 = 0.02$
$\beta_{H,GDP} = \beta_{A,GDP} - \beta_{B,GDP} = 0$
$\beta_{H,CS} = \beta_{A,CS} - \beta_{B,CS} = 0$

Therefore, the net investment in Portfolio H is zero (invest \$1 in Asset A for every \$1 sold short in Asset B), the net position for Portfolio H is riskless (i.e., factor betas are zero), but the expected profit from Portfolio H is positive (equal to 2%). These conditions constitute an arbitrage situation.

WELL-DIVERSIFIED PORTFOLIOS

LO 12.3: Describe properties of well-diversified portfolios and explain the impact of diversification on the residual risk of a portfolio.

The part of an individual security's risk that is uncorrelated with the volatility of the market portfolio is that security's **nonsystematic risk** (or *diversifiable risk*). The part of an individual security's risk that arises because of the positive covariance of that security's returns with overall market returns is called its **systematic risk**. As the number of securities in a portfolio becomes large, the portfolio's nonsystematic risk approaches zero. In other words, portfolio risk reduction through diversification comes from reducing nonsystematic risk. Therefore, when a risky security is added to a well-diversified (efficient) portfolio, the portfolio's risk is only affected by the systematic risk of that security.

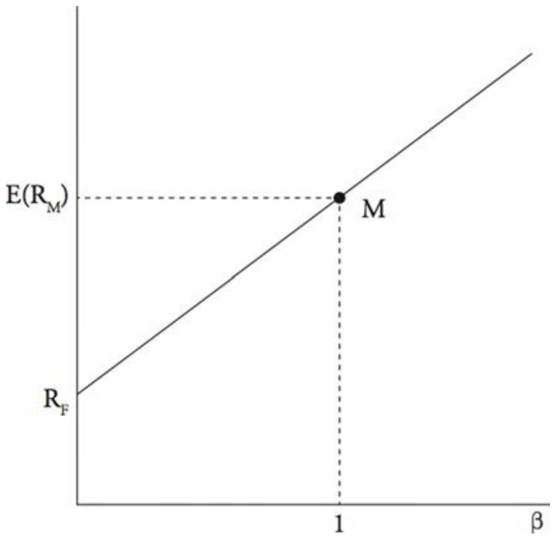
The standardized measure of systematic risk is **beta**, standardized into units of market risk, which is the risk of holding the market portfolio (often represented by the S&P 500 Index). Recall from Topic 10 that beta is calculated as the covariance of the returns on security or portfolio *i* with the returns on the market portfolio, divided by the variance of the returns on the market portfolio.

Because nonsystematic (diversifiable) risk can be avoided (without cost) by efficient diversification, there is no added expected return for bearing nonsystematic risk. This result is the crucial point of the **capital asset pricing model** (CAPM) and is expressed in the equation of the **security market line** (SML). As we saw in previous topics, this relation says that, for each unit of market risk (beta), investors can expect to receive a premium over the risk-free rate equal to the market risk premium.

THE SINGLE-FACTOR SECURITY MARKET LINE

Assume we create a well-diversified, observable, market index portfolio, M. Index M can be any well-diversified portfolio thought to be highly correlated with the systematic factor that affects the returns of assets. Also, assume that we use a single-factor model in which the factor is the unexpected return on the market index portfolio. In this case, the beta of the market index is equal to one. Portfolio M must lie on the line illustrated in Figure 1, which is known as the **single-factor security market line** (SML).

Figure 1: The Single-Factor Security Market Line



The implication of the single-factor security market line is that, when no arbitrage opportunities exist, all well-diversified portfolios must lie on the line.

To derive the equation for the single-factor SML, note that the intercept of the line is the risk-free rate, R_F, and the slope of the line is the market index risk premium, $E(R_M) - R_F$.

The equation for the line (for any well-diversified Portfolio P) is:

$$E(R_P) = R_F + \beta_P[E(R_M) - R_F]$$

where M is an observable, well-diversified, market index, and β_P is the beta of any portfolio, P, relative to the market index, M.

The equation is analogous to the CAPM. The key difference is that the CAPM relies on the existence of the mean-variance efficient market portfolio (i.e., an unobservable portfolio that lies on the efficient frontier, and consists of all marketable assets). In contrast, the equation for the single-factor security market line merely relies on the assumptions that security returns can be explained by a single-factor model, that well-diversified portfolios can be created, and that no arbitrage opportunities exist.

HEDGING EXPOSURES TO MULTIPLE FACTORS

LO 12.4: Explain how to construct a portfolio to hedge exposure to multiple factors.

Consider an investor who manages a portfolio with the following factor betas:

GDP beta = 0.50
Consumer sentiment beta = 0.30

Assume the investor wishes to pursue strategies to hedge exposure to GDP risk, or to consumer sentiment risk, or to both factor risks. The following explanation makes use of what are called **factor portfolios**, which are well-diversified portfolios with betas equal to one for a single risk factor and betas equal to zero on all remaining factors. For example, the GDP factor portfolio is a well-diversified portfolio designed to have a GDP beta of one and a consumer sentiment beta of zero. And, the consumer sentiment factor portfolio is a well-diversified portfolio designed to have a consumer sentiment beta of one and a GDP beta of zero.

Now, assume the investor wishes to hedge away GDP factor risk, yet maintain the 0.30 exposure to consumer sentiment. To do so, the investor should combine the original portfolio with a 50% short position in the GDP factor portfolio. The GDP factor beta on the 50% short position in the GDP factor portfolio equals –0.50, which perfectly offsets the 0.50 GDP factor beta on the original portfolio. The combined long and short positions hedge away GDP risk but retain the consumer sentiment exposure.

Alternatively, the investor might want to hedge away consumer sentiment (CS) factor risk, yet maintain the 0.50 exposure to GDP. To do so, the investor should combine the original portfolio with a 30% short position in the CS factor portfolio. The CS factor beta on the 30% short position in the CS factor portfolio equals –0.30, which perfectly offsets the 0.30 CS factor beta on the original portfolio. The combined long and short positions hedge away CS risk but retain the GDP exposure.

Finally, what if the investor wants to hedge away both factor risks? To do so, first, the investor should form a portfolio invested 50% in the GDP factor portfolio and 30% in the CS factor portfolio (and the remaining 20% in the risk-free asset). This portfolio can be referred to as Portfolio H, which can be used to hedge away the factor risks of the original portfolio. To hedge away the factor risks of the original portfolio, the investor can combine the original portfolio with a short position in the hedge portfolio, H. That way, the original portfolio factor betas (0.50 and 0.30, respectively) are perfectly offset by the short position in the hedge portfolio.

The hedging process can also be used to exploit an arbitrage opportunity. Assume that the original portfolio expected return is 12% and that the hedge portfolio return equals 10%. In this case, the investor can take a long position in the original portfolio combined with a short position in the hedge portfolio, resulting in a 2% arbitrage profit. Conversely, if the hedge portfolio return instead equals 14%, the investor can take a long position in the hedge portfolio combined with a short position in the original portfolio, resulting in a 2% arbitrage profit.

THE ARBITRAGE PRICING THEORY

LO 12.5: Describe and apply the Fama-French three factor model in estimating asset returns.

The arbitrage pricing theory (APT) describes expected returns as a linear function of exposures to common (i.e., macroeconomic) risk factors:

$$E(R_i) = R_F + \beta_{i1}RP_1 + \beta_{i2}RP_2 + \ldots + \beta_{ik}RP_k$$

where RP_j is the risk premium associated with risk factor *j*. The risk premiums are derived as follows:

Step 1: Create factor portfolios. Each factor portfolio is a well-diversified portfolio (e.g., nonsystematic risk is zero) that has a beta equal to one for a single risk factor, and betas equal to zero on the remaining factors. Repeat the process for all *k* factors in the multifactor model so that a factor portfolio is derived for each of the risk factors.

Step 2: Derive returns for each factor portfolio. For instance, define $E(R_1)$ as the expected return on Factor Portfolio 1, $E(R_2)$ as the expected return on Factor Portfolio 2, and so on.

Step 3: Calculate risk premiums for each factor portfolio. For example, the risk premium for Factor Portfolio 1 equals $E(R_1) - R_F$, the risk premium for Factor Portfolio 2 equals $E(R_2) - R_F$, and so on.

Given the derivation of the risk premiums, the APT model can be rewritten as:

$$E(R_i) = R_F + \beta_{i1}[E(R_1) - R_F] + \beta_{i2}[E(R_2) - R_F] + \ldots + \beta_{ik}[E(R_k) - R_F]$$

The assumptions underlying the APT model are as follows:

- Returns follow a *k*-factor process: $R_i = E(R_i) + \beta_{i1}F_1 + \beta_{i2}F_2 + \ldots + \beta_{ik}F_k + e_i$.
- Well-diversified portfolios can be formed.
- No arbitrage opportunities exist.

Professor's Note: The main conclusion of the APT is that if these three assumptions hold, then expected returns on well-diversified portfolios are proportional to their factor betas. However, we cannot conclude that the APT relationship will hold for ALL securities. For example, if the APT relation is violated for, say, one security in the portfolio, its effect will be too small to produce meaningful arbitrage opportunities for the portfolio. Therefore, we can conclude that the APT relation can hold for well-diversified portfolios even if it does not hold for all securities in the portfolio. But, the APT relation must hold for nearly all securities in a well-diversified portfolio, or else arbitrage opportunities will become available for the portfolio. Therefore, we can conclude that the APT relation must hold for NEARLY all securities.

Example: Compute expected return using the APT model

Assume the following data for Asset Z:

Risk-free rate = 5%
GDP factor beta = 0.50
Consumer sentiment factor beta = 0.30
GDP risk premium = 4%
Consumer sentiment risk premium = 3%

Calculate the expected return for Asset Z using a 2-factor APT model.

Answer:

$$E(R_Z) = 0.05 + 0.5(0.04) + 0.3(0.03) = 0.079 = 7.9\%$$

Both the arbitrage pricing theory model and the capital asset pricing model describe equilibrium expected returns for assets. In fact, the CAPM can be considered a special restrictive case of the APT in which there is only one risk factor (the market risk factor).

The Fama-French Three-Factor Model

A major weakness of the APT is that it offers no guidance as to the identification of the appropriate risk factors. More recently, a competing model has been developed by Professors Eugene Fama and Kenneth French. In contrast to the APT model, the Fama-French model identifies the factors. In addition to the market return factor ($R_M - R_F$), the Fama-French three-factor model specifies the following two factors:

- SMB (small minus big) is the firm size factor equal to the difference in returns between portfolios of small and big firms ($R_S - R_B$).
- HML (high minus low) is the book-to-market (i.e., book value per share divided by stock price) factor equal to the difference in returns between portfolios of high and low book-to-market firms ($R_H - R_L$).

Notice that SMB is a hedge strategy long small firms and short big firms. Likewise, HML is a hedge strategy long high book-to-market firms and short low book-to-market firms.

The equation for the Fama-French three-factor model is:

$$R_i - R_F = \alpha_i + \beta_{i,M}(R_M - R_F) + \beta_{i,SMB}SMB + \beta_{i,HML}HML + e_i$$

The intercept term (i.e., alpha) equals the abnormal performance of the asset after controlling for its exposures to the market, firm size, and book-to-market factors. In equilibrium, the intercept should equal zero, assuming the Fama-French three factors adequately capture all systematic risks.

The SMB and HML factors are chosen because history shows that returns are higher on small versus big firms and on high versus low book-to-market firms. Fama and French argue that these differences exist because small firms are inherently riskier than big firms, and that high book-to-market firms are inherently riskier than low book-to-market firms.

KEY CONCEPTS

LO 12.1

The inputs to a multifactor model, for any stock, are:

- Expected return for the stock.
- Factor betas.
- Deviation of macroeconomic factors from their expected values.
- Firm-specific return.

The factor beta equals the sensitivity of the stock return to a 1-unit change in the factor. The firm-specific return is that portion of the stock's return that is unexplained by the macro factors. The expected value of the firm-specific return equals zero, because, by definition, firm-specific events are random.

LO 12.2

The equation for a *k*-factor model is: $R = E(R) + \beta_1 F_1 + \beta_2 F_2 + \ldots + \beta_k F_k + e$. The return equals its expected value if none of the macro factors deviate from their expected values and if the firm-specific return equals zero. If macro factor F_j deviates from its expected value, then F_j is nonzero. If the firm experiences a nonfactor related surprise, then the firm-specific component, e, will be nonzero. The multifactor model can be used to calculate the expected return after new macroeconomic and/or firm-specific information is released.

LO 12.3

Risk reduction benefits achieved through diversification come from reducing nonsystematic risk. Therefore, the expected return on a well-diversified portfolio is determined by systematic risk as measured by beta.

A single-factor security market line (SML) is analogous to the capital asset pricing model (CAPM). In the single-factor SML, systematic risk is measured as the exposure of the asset to a well-diversified market index portfolio. The index portfolio can be any well-diversified portfolio thought to be highly correlated with the systematic factor that affects the returns of assets. The equation for the single-factor SML for any well-diversified portfolio is: $E(R_P) = R_F + \beta_P[E(R_M) - R_F]$, where R_F is the risk-free rate, M is an observable well-diversified market index, and β_P is the beta of any portfolio, P, relative to the market index.

LO 12.4

A multifactor model can be used to hedge away multiple factor risks. To do so, the investor can create factor portfolios, which are well-diversified portfolios with beta equal to one for a single risk factor, and betas equal to zero on the remaining risk factors. Factor portfolios can be used to hedge multiple risk factors by combining the original portfolio with offsetting positions in the factor portfolios.

LO 12.5

The arbitrage pricing theory describes expected returns as a linear function of exposures to common (i.e., macroeconomic) risk factors: $E(R_i) = R_F + \beta_{i1}RP_1 + \beta_{i2}RP_2 + \ldots + \beta_{ik}RP_k$, where RP_j is the risk premium associated with risk factor *j*.

The CAPM is a special case of the APT where there is only one priced risk factor (market risk).

The Fama-French three-factor model describes returns as a linear function of the market index return, firm size, and book-to-market factors. The firm size factor, SMB, equals the difference in returns between portfolios of small and big firms. The book-to-market factor, HML, equals the difference in returns between portfolios of high and low book-to-market firms.

CONCEPT CHECKERS

1. Which of the following is least likely to be one of the inputs to a multifactor model?
   A. The mean-variance efficient market portfolio.
   B. Factor betas.
   C. Deviations of factor values from their expected values.
   D. Firm-specific returns.

2. Suppose an analyst examines expected returns for the BroadBand Company (BBC) based on a 2-factor model. Initially, the expected return for BBC equals 10%. The analyst identifies GDP and 10-year interest rates as the two factors for the factor model. Assume the following data is used:

   GDP growth consensus forecast = 6%
   Interest rate consensus forecast = 3%
   GDP factor beta for BBC = 1.50
   Interest rate factor beta for BBC = –1.00

   Suppose GDP ends up growing 5% and the 10-year interest rate ends up equaling 4%. Also assume that during the period, the BroadBand Company unexpectedly experiences shortages of key inputs, causing its revenues to be less than originally expected. Consequently, the firm-specific return is –2% during the period. Using the 2-factor model with the revised data, which of the following expected returns for BBC is correct?
   A. 1.5%.
   B. 3.5%.
   C. 5.5%.
   D. 6.5%.

3. Which of the following statements is least likely a requirement for an arbitrage opportunity? The arbitrage situation leads to a:
   A. risk-free opportunity.
   B. zero net investment opportunity.
   C. profitable opportunity.
   D. return in excess of the risk-free rate opportunity.

4. Which of the following assumptions is not made when forming a single-factor security market line?
   A. Security returns are described by a factor model.
   B. A mean-variance efficient market portfolio exists.
   C. Well-diversified portfolios can be formed.
   D. No arbitrage opportunities exist.

5. Suppose Portfolio P has factor betas of 0.40 and 0.50 on two risk factors (risk factors 1 and 2, respectively). Assume a portfolio manager wishes to hedge away all of the exposure to the two risk factors, yet does not want to sell the portfolio. Which of the following strategies is expected to achieve the desired result?

A. Short sell a hedge portfolio that allocates 40% to the first factor portfolio, 50% to the second factor portfolio, and 10% to the risk-free asset.
B. Short sell a hedge portfolio that allocates 90% to the market portfolio and 10% to the risk-free asset.
C. Buy a hedge portfolio that allocates 40% to the first factor portfolio, 50% to the second factor portfolio, and 10% to the risk-free asset.
D. Buy a hedge portfolio that allocates 90% to the market portfolio and 10% to the risk-free asset.

CONCEPT CHECKER ANSWERS

1. **A** The mean-variance efficient market portfolio is essential to the capital asset pricing model, but is not required in multifactor models.

2. **C** $R_{BBC} = E(R_{BBC}) + \beta_{BBC,GDP}F_{GDP} + \beta_{BBC,IR}F_{IR} + e_{BBC}$
   $R_{BBC} = 0.10 + 1.5(-0.01) - 1(0.01) - 0.02 = 0.055 = 5.5\%$

3. **D** An arbitrage situation exists if a risk-free, zero net investment can be created that produces a positive profit. The arbitrage return need not exceed the risk-free rate.

4. **B** The derivation of the single-factor security market line does not rely on the assumption that a mean-variance efficient market portfolio exists. This is in contrast with the capital asset pricing model, which relies on the existence of the mean-variance efficient market portfolio.

5. **A** A factor portfolio is a well-diversified portfolio that has a factor beta equal to one for a single risk factor, and factor betas equal to zero on the remaining factors. By shorting the hedge portfolio, the investor will offset the factor risks of the original portfolio. In this case, the 0.40 and 0.50 exposures to the two risk factors are offset by the short position in the hedge portfolio that also has 0.40 and 0.50 exposures to the two risk factors.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

PRINCIPLES FOR EFFECTIVE RISK DATA AGGREGATION AND RISK REPORTING

Topic 13

EXAM FOCUS

This is a highly qualitative topic that explores the Basel Committee's principles for effective risk data aggregation and reporting. Much of this topic is practical, in terms of the need for the data to be accurate, complete, timely, comprehensive, and adaptable. Governance principles are important, and the committee notes that risk data aggregation and reporting is expensive, and, as a result, senior management and the board of directors should be fully invested in the process so that adequate resources are devoted to the effort. Risk reporting should also be accurate, comprehensive, clear, and useful. For the exam, understand how data aggregation principles interact and know that the committee implores banks to meet the requirements of each principle while still meeting the other principles. In other words, the bank should not put one principle ahead of another.

BENEFITS OF RISK DATA AGGREGATION

LO 13.1: Explain the potential benefits of having effective risk data aggregation and reporting.

According to the Basel Committee on Banking Supervision, **risk data aggregation** means "defining, gathering and processing risk data according to the bank's risk reporting requirements to enable the bank to measure its performance against its risk tolerance/ appetite." The aggregation process includes breaking down, sorting, and merging data and datasets. Risk management reports should reflect risks in a reliable way.

Several benefits accrue to banks that have effective risk data aggregation and reporting systems in place. These benefits include:

- An increased ability to **anticipate problems**. Aggregated data allows risk managers to understand risks holistically. It is easier to see problems on the horizon when risks are viewed as a whole rather than in isolation.
- In times of financial stress, effective risk data aggregation enhances a bank's ability to **identify routes to return to financial health**. For example, a bank may be better able to identify a suitable merger partner in order to restore the bank's financial viability.
- **Improved resolvability** in the event of bank stress or failure. Regulatory authorities should have access to aggregated risk data to resolve issues related to the health and viability of banks. This is especially important for global systemically important banks (G-SIBs).
- By strengthening a bank's risk function, the bank is better able to make strategic decisions, **increase efficiency, reduce the chance of loss, and ultimately increase profitability.**

GOVERNANCE

LO 13.2: Describe key governance principles related to risk data aggregation and risk reporting practices.

During the global financial crisis that began in 2007, many banks were unable to quickly and accurately identify concentrations of risk across business lines and at the bank group level due, in part, to an inability to aggregate risk exposures and report bank-wide risks effectively. As part of the Basel Committee's push for greater corporate governance, the committee issued supplemental Pillar 2 guidance regarding capital models and other key risk management models (e.g., value at risk) to improve banks' capabilities regarding the recognition and management of bank-wide risks.

Principle 1—Governance

According to the committee, "a bank's risk data aggregation capabilities and risk reporting practices should be subject to strong governance arrangements consistent with the other principles and guidance established by the Basel Committee."

The governance principle suggests that risk data aggregation should be part of the bank's overall risk management framework. To ensure that adequate resources are devoted to data aggregation and reporting, senior management should approve the framework before implementation.

Data aggregation and risk reporting practices should be:

- Fully documented.
- Independently reviewed and validated by individuals with expertise in information technology (IT) and data and risk reporting functions.
- Considered when the firm undergoes new initiatives, including new product development, acquisitions, and/or divestitures. As part of an acquisition, the bank should assess the risk data aggregation and reporting capabilities of the target firm and explicitly evaluate those capabilities when deciding whether to make the acquisition. In addition, a time frame should be established to integrate the risk data aggregation and reporting processes of the two firms.
- Unaffected by the bank's structure. Specifically, decisions regarding data aggregation and reporting should be independent of the bank's physical location or geographical presence and/or legal organization.
- A priority of senior management, who should support risk data aggregation and reporting processes with financial and human resources. Senior management should include risk data aggregation and reporting in strategic IT planning and ensure that the implementation of these processes is not impeded.
- Supported by the board of directors, which should remain aware of the bank's implementation of and compliance with the key governance principles set out by the Basel Committee.

DATA ARCHITECTURE AND IT INFRASTRUCTURE

LO 13.3: Identify the data architecture and IT infrastructure features that can contribute to effective risk data aggregation and risk reporting practices.

IT systems are expensive, and risk aggregation and reporting systems require significant commitments of financial and human resources. Benefits from these investments are generally realized over the long-term, not the short-term. As the memories of the recent financial crisis fade, banks may not give priority to the needed IT investment. The Basel Committee believes that the long-term benefits of improving risk aggregation and reporting processes will outweigh the banks' investments.

Principle 2—Data Architecture and Infrastructure

According to the committee, "a bank should design, build and maintain data architecture and IT infrastructure which fully supports its risk data aggregation capabilities and risk reporting practices not only in normal times but also during times of stress or crisis, while still meeting the other Principles."

Principle 2, as referenced in Principle 1, implores the bank to devote financial and human resources to risk data aggregation and reporting, both when the bank is financially sound and when the bank is struggling due to financial stresses. Principle 2 requires that:

- Risk data aggregation and reporting practices should be a part of the bank's planning processes and subject to business impact analysis.
- Banks establish integrated data classifications and architecture across the banking group. Multiple data models may be used as long as there are robust automated reconciliation measures in place. Data architecture should include information on data characteristics (metadata) and naming conventions for legal entities, counterparties, customers, and account data.
- Accountability, roles, responsibilities, and ownership should be defined relative to the data. Adequate controls should be in place throughout the lifecycle of the data for all aspects of the technology infrastructure. Risk managers, business managers, and/or IT functions are responsible for data, ensuring that it is entered correctly, is relevant and current, is aligned with data taxonomies, and is consistent with bank policies.

RISK DATA AGGREGATION CAPABILITIES

LO 13.4: Describe characteristics of a strong risk data aggregation capability and demonstrate how these characteristics interact with one another.

Principle 3—Accuracy and Integrity

According to the committee, "a bank should be able to generate accurate and reliable risk data to meet normal and stress/crisis reporting accuracy requirements. Data should be aggregated on a largely automated basis so as to minimize the probability of errors."

Principle 3 requires that:

- Data aggregation and reporting should be accurate and reliable.
- Controls applied to risk data should be as robust as those surrounding accounting data.
- To ensure the quality of the data, effective controls should be in place when the bank relies on manual processes and desktop applications such as spreadsheets and databases.
- Data should be reconciled with other bank data, including accounting data, to ensure its accuracy.
- A bank should endeavor to have a single authoritative source for risk data for each specific type of risk.
- Risk personnel should have access to risk data to effectively aggregate, validate, reconcile, and report the data in risk reports.
- Data should be defined consistently across the bank. The bank may maintain a dictionary of risk data concepts and terms.
- While data should be aggregated on a largely automated basis to reduce the risk of errors, human intervention is appropriate when professional judgments are required. There should be balance between manual and automated risk management systems.
- Bank supervisors expect banks to document manual and automated risk data aggregation systems and explain when there are manual workarounds, why the workarounds are critical to data accuracy, and propose actions to minimize the impact of manual workarounds.
- Banks monitor the accuracy of risk data and establish plans to correct poor data quality.

Principle 4—Completeness

According to the committee, "a bank should be able to capture and aggregate all material risk data across the banking group. Data should be available by business line, legal entity, asset type, industry, region and other groupings, as relevant for the risk in question, that permit identifying and reporting risk exposures, concentrations and emerging risks."

Principle 4 requires that:

- Both on- and off-balance sheet risks should be aggregated.
- Risk measures and aggregation methods should be clear and specific enough that senior managers and the board of directors can properly assess risk exposures. However, not all risks need to be expressed in the same metric.
- Bank risk data should be complete. If risk data is not complete, the bank should identify and explain areas of incompleteness to bank supervisors.

Principle 5—Timeliness

According to the committee, "a bank should be able to generate aggregate and up-to-date risk data in a timely manner while also meeting the principles relating to accuracy and integrity, completeness and adaptability. The precise timing will depend upon the nature and potential volatility of the risk being measured as well as its criticality to the overall risk profile of the bank. The precise timing will also depend on the bank specific frequency requirements for risk management reporting, under both normal and stress/crisis situations, set based on the characteristics and overall risk profile of the bank."

Principle 5 requires that:

- Risk data aggregation should be timely and should meet all requirements for risk management reporting. Bank supervisors will review the timeliness and specific frequency requirements of bank risk data in normal and stress/crisis periods.
- Systems should be in place to produce aggregated risk data quickly in stress/crisis situations for all critical risks. Critical risks include, but are not limited to:
  - Aggregated credit exposures to large corporate borrowers.
  - Counterparty credit risk exposures, including derivatives.
  - Trading exposures, positions, and operating limits.
  - Market concentrations by region and sector.
  - Liquidity risk indicators.
  - Time-critical operational risk indicators.

Principle 6—Adaptability

According to the committee, "a bank should be able to generate aggregate risk data to meet a broad range of on-demand, ad hoc risk management reporting requests, including requests during stress/crisis situations, requests due to changing internal needs and requests to meet supervisory queries."

Principle 6 requires that:

- Data aggregation capabilities should be adaptable and flexible. Adaptable data makes it easier for managers and the board of directors to conduct stress tests and scenario analysis. Data should be available for ad hoc data requests to assess emerging risks. Adaptability includes:
  - Aggregation processes should be flexible and should allow bank managers to assess risks quickly for decision-making purposes.
  - Data should be customizable (e.g., anomalies, dashboards, and key takeaways) and should allow the user to investigate specific risks in greater detail.
  - It should be possible to include new aspects of the business or outside factors that influence overall bank risk in the risk data aggregation process.
  - Regulatory changes should be incorporated in risk data aggregation.
- A bank should be able to pull out specifics from aggregated risk data. For example, a bank should be able to aggregate risks of a certain country or region. Credit risk exposures (e.g., corporate, bank, sovereign and retail exposures) for a specific country should be readily accessible. Data regarding risks across geographic areas or business lines should be available as needed.

The principles of accuracy and integrity, completeness, timeliness, and adaptability interact; a bank may choose to put one principle ahead of another, or the data is aggregated with one principle in mind while ignoring another. For example, in the interest of speed and timeliness, a bank could take shortcuts with respect to completeness. Also, the accuracy and integrity of the data may suffer if a bank is in a hurry to comply with the timeliness standard. In addition, the data could be compiled in such a way that supports accuracy and integrity, but makes the data inflexible and not easily adaptable for specific needs. The bank should consider all the standards when creating and maintaining a risk data aggregation framework.

EFFECTIVE RISK REPORTING PRACTICES

LO 13.5: Describe characteristics of effective risk reporting practices.

Effective **risk reporting practices** include:

- Clear, complete, timely, and accurate data.
- Risk data is reported to the right people at the right time. In other words, the key decision-makers should have access to the data in a timely fashion to allow for good decision-making.

Principle 7—Accuracy

According to the committee, "risk management reports should accurately and precisely convey aggregated risk data and reflect risk in an exact manner. Reports should be reconciled and validated."

Principle 7 requires that:

- Risk reports should be accurate and precise. Senior managers and board members should be able to use the reports to make critical decisions about bank risks.
- To ensure the accuracy of risk reports the bank should:
  - Define the processes used to create risk reports.
  - Create reasonableness checks of the data.
  - Include descriptions of mathematical and logical relationships in the data that should be verified.
  - Create error reports that identify, report, and explain weaknesses or errors in the data.
- The bank should ensure the reliability, accuracy, and timeliness of risk approximations (e.g., scenario analysis, sensitivity analysis, stress testing, and other risk modeling approaches).
- The board of directors and senior managers should establish precision and accuracy requirements for regular and stress/crisis risk reports. The reports should include information on positions and exposures in the market. The criticality of decisions made using the data should be clearly stated.
- Bank supervisors expect banks to impose accuracy requirements on risk data (both regular and stress/crisis) commensurate with and analogous to accounting materiality. For example, if an omission influences risk decision-making, then it is deemed material.

Principle 8—Comprehensiveness

According to the committee "risk management reports should cover all material risk areas within the organization. The depth and scope of these reports should be consistent with the size and complexity of the bank's operations and risk profile, as well as the requirements of the recipients."

Principle 8 requires that:

- Reports should contain position and risk exposure information for all relevant risks, such as credit risk, liquidity risk, market risk, and operational risk. The report should also include detailed information for specific risks. For example, credit risk reports should include information on the country, region, sector, industry, and/or single name exposures. Risk related measures such as the bank's regulatory capital should also be included in risk reports.
- Risk reports should be forward-looking and should include forecasts and stress tests. The bank's risk appetite/tolerance should be discussed in the context of emerging risks. Recommendations for reducing risk should be included where appropriate. Senior managers and the board of the directors should gain a sense of the bank's future capital and risk profiles from reports.
- Bank supervisors should be satisfied that the bank's risk reporting is sufficient in terms of coverage, analysis, and comparability across institutions. A risk report should include, but not be limited to, information regarding:
    - Credit risk.
    - Market risk.
    - Liquidity risk.
    - Operational risk.
    - Results of stress tests.
    - Capital adequacy.
    - Regulatory capital.
    - Liquidity projections.
    - Capital projections.
    - Risk concentrations.
    - Funding plans.

Principle 9—Clarity and Usefulness

According to the committee "risk management reports should communicate information in a clear and concise manner. Reports should be easy to understand yet comprehensive enough to facilitate informed decision-making. Reports should include meaningful information tailored to the needs of the recipients."

Principle 9 requires that:

- Reports be tailored to the end user (e.g., the board, senior managers, and risk committee members) and should assist them with sound risk management and decision-making.
- Reports will include:
    - Risk data.
    - Risk analysis.
    - Interpretation of risks.
    - Qualitative explanations of risks.

  Different members of the organization have different needs in terms of reporting. For example, information relevant to the risk committee may not be specifically relevant to the board of directors. Aggregation increases as the report moves up the organizational hierarchy (i.e., to senior managers and to the board). There is a greater need for qualitative interpretation and explanation as aggregation increases.

- The board of directors should ensure the bank is operating within its risk tolerance/appetite, and should therefore make sure that it is asking for and receiving relevant risk information to make the determination. The board should tell senior management if the amount/type of data it is receiving is insufficient or redundant. The mix of quantitative data versus qualitative data is important. Senior management should also ensure that it is getting the right mix of information to foster good risk decisions.
- Risk data should be classified, and the bank should develop an inventory of terms used in risk reports.
- Bank supervisors will confirm periodically that the risk data is clear, relevant, and useful for decision-making.

Principle 10—Frequency

According to the committee, "the board and senior management (or other recipients as appropriate) should set the frequency of risk management report production and distribution. Frequency requirements should reflect the needs of the recipients, the nature of the risks reported, and the speed at which the risks can change, as well as the importance of reports in contributing to sound risk management and effective and efficient decision-making across the bank. The frequency of reports should be increased during times of stress/crisis."

Principle 10 requires that:

- The frequency of reports will vary depending on the recipient (e.g., the board, senior managers, and risk committee members), the type of risk, and the purpose of the report. The bank should periodically test whether reports can be accurately produced in the established time frame both in normal and stress/crisis periods.
- In stress/crisis periods, liquidity, credit, and market risk reports may be required immediately in order to react to the mounting risks.

Principle 11—Distribution

According to the committee, "risk management reports should be distributed to the relevant parties while ensuring confidentiality is maintained."

Principle 11 requires that:

- Reports should be disseminated in a timely fashion while maintaining confidentiality where required. Supervisors expect banks to confirm that recipients receive reports in a timely manner.

Professor's Note: There are a total of 14 principles for effective risk data aggregation and risk reporting set out by the Basel Committee on Banking Supervision. Principles 12–14 describe the role of bank supervisors in reviewing and evaluating a bank's risk aggregation and reporting practices and are not discussed here, because the LOs for this topic focus on Principles 1–11.

KEY CONCEPTS

LO 13.1

Benefits that accrue from effective risk data aggregation and reporting include: (1) an increased ability of managers and the board to anticipate problems, (2) enhanced ability to identify alternative routes to restore financial health in times of financial stress, (3) improved resolvability in the event of bank stress or failure, and (4) an enhanced ability to make strategic decisions, increasing the bank's efficiency, reducing the chance of loss and ultimately increasing bank profitability.

LO 13.2

The governance principle (Principle 1) suggests that risk data aggregation should be part of the bank's overall risk management framework. The board and senior management should assure that adequate resources are devoted to risk data aggregation and reporting.

LO 13.3

The data architecture and IT infrastructure principle (Principle 2) states that a bank should design, build, and maintain data architecture and IT infrastructure which fully supports its risk data aggregation capabilities and risk reporting practices not only in normal times but also during times of stress or crisis, while still meeting the other principles. It stresses that banks should devote considerable financial and human resources to risk data aggregation and reporting.

LO 13.4

Principles 3–6 specify standards and requirements for effective risk data aggregation. Banks should ensure that the data is accurate and has integrity (Principle 3), is complete (Principle 4), is timely (Principle 5), and is adaptable to the end user (Principle 6). In addition, the bank should not have high standards for one principle at the expense of another. Aggregated risk data should exhibit all of the features together, not in isolation.

LO 13.5

Principles 7–11 specify standards and requirements for effective risk reporting practices. Risk reports should be accurate (Principle 7), comprehensive (Principle 8), and clear and useful (Principle 9). Principle 10 states that reports should be "appropriately frequent" (i.e., frequency depends on the role of the recipient—board members need reports less frequently than risk committee members). Reports should be distributed to relevant parties in a timely fashion while maintaining confidentially (Principle 11).

CONCEPT CHECKERS

1. Jeffrey Gibson, a bank supervisor with a national regulatory agency, has requested as part of a bank examination, that Star Bank, a global systemically important bank (G-SIB), improve its aggregation and reporting of risk data. Star Bank has experienced significant losses resulting from multiple causes, ranging from poor lending decisions to bad decisions regarding the use of derivatives. The bank is now undercapitalized because of losses. Gibson refers Star Bank's risk managers to the Basel Committee's recommendations for effective risk data aggregation. He informs risk committee members and senior management that one of the potential direct benefits of effective risk data aggregation, particularly in light of Star Bank's current troubles, is:
   A. increased bank efficiency.
   B. more effective IT infrastructure.
   C. improved resolvability of bank problems.
   D. a clearer definition of the bank's risk appetite.

2. Donna Grinstead is the risk management officer at Republic Bank. She is establishing governance principles for effective risk data aggregation. The bank has historically been lenient with respect to risk management processes, and Grinstead has been hired to remedy the situation. Which of the following statements regarding governance principles is false?
   A. The overall risk management framework of the bank should include risk data aggregation.
   B. Human and financial resources should be devoted to risk data aggregation, and thus senior management should approve the framework.
   C. A bank should have multiple sources for risk data for each type of risk to improve reliability.
   D. Risk data aggregation should be considered when the firm undergoes new initiatives, including acquisitions and divestitures.

3. A bank should include information on data characteristics (metadata) and naming conventions for legal entities, counterparties, customers, and account data in aggregated risk data. This is suggested by the Basel Committee on Banking Supervision in the principle related to:
   A. accuracy.
   B. completeness.
   C. clarity and usefulness.
   D. data architecture and infrastructure.

4. Emily Lister, a risk management specialist at American Bank and Trust, has been asked, as part of Principle 3 on the accuracy and integrity of aggregated risk data, to provide a report to bank supervisors on why a bank employee decided to forgo the automated processes put in place by the risk management team and write data entries by hand. Lister believes it was necessary after discussing the action with the employee. In her report, she details why it was necessary for the employee to forgo automated processes and why she believes the integrity of the data is still intact. In the report, she is describing a(n):
   A. breach of protocol.
   B. manual workaround.
   C. reliability exception to Principle 3.
   D. unexcused exception to risk data aggregation principles.

5. Senior management and the board of directors should receive accurate and timely aggregated risk data reports for all of the following reasons except:
   A. bank supervisors request risk reports from board members, who should be prepared to provide this information during bank examinations.
   B. senior management and board members use risk reports to make decisions regarding bank risks.
   C. senior management and board members should react in times of financial stress and/or crisis and need reliable risk reports to make good decisions.
   D. the board should ensure that the bank is operating within its risk tolerance/appetite and should therefore make sure that it receives relevant risk information.

CONCEPT CHECKER ANSWERS

1. **C** There are several benefits that accrue to banks that have effective risk data aggregation and reporting systems in place. These benefits include an increased ability to anticipate problems. Also, in times of severe financial stress, effective risk data aggregation enhances a bank's ability to identify alternative routes to restore financial health. Regulatory authorities should have access to aggregated risk data to resolve issues related to bank health and viability. This aids regulators in resolving problems in the event of financial stress. By strengthening a bank's risk function, the bank is better able to make strategic decisions, increase efficiency, reduce the probability of loss and ultimately increase profitability. In this case, the bank appears to be in financial stress, so the most relevant benefit is improved resolvability.

2. **C** Governance principles for risk data aggregation relate to overall bank processes and the roles of senior management and the board in supporting risk data aggregation and reporting. Data sources relate to the accuracy and integrity of the data, not governance. In addition, the bank should strive to have a single source for risk data, not multiple sources.

3. **D** Principle 2, data architecture and infrastructure, requires that risk data aggregation and reporting practices should be a part of the bank's planning processes and subject to business impact analysis. Banks should establish integrated data classifications and architecture across the banking group. Multiple data models may be used as long as there are robust automated reconciliation measures in place. In addition, data architecture should include information on data characteristics (metadata) and naming conventions for legal entities, counterparties, customers, and account data.

4. **B** As part of Principle 3 on the accuracy and integrity of aggregated risk data, bank supervisors expect banks to document manual and automated risk data aggregation systems and explain when there are manual workarounds, why the workarounds are critical to data accuracy, and propose actions to minimize the impact of a manual workaround.

5. **A** It is important for the board and senior management to have accurate and timely risk reports to oversee the bank's risk-taking activities. The bank's risk tolerance/appetite is monitored by the board. The board and senior managers should be prepared to make decisions in times of financial stress and crisis. The board does not provide reports to regulators. Information requests from supervisors would be made at the bank level, not the board level.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

GARP CODE OF CONDUCT

Topic 14

EXAM FOCUS

This topic addresses the GARP Code of Conduct which sets forth principles related to ethical behavior within the risk management profession. FRM candidates are expected to know all Member responsibilities as well as sanctions that could result if violations of the Code occur. The material in this topic is relatively easy to understand; however, for the exam, you should expect complex questions related to these ethical standards that test whether or not a violation has occurred.

The GARP Code of Conduct contains a set of key principles designed to support financial risk management practices. The Code was developed for the Financial Risk Manager (FRM) program as well as other certification programs administered by the Global Association of Risk Professionals (GARP). All GARP Members (including FRM candidates) are expected to abide by the principles outlined in the Code and are subject to consequences, such as suspensions, for violating any parts of the Code.

A GARP Member should understand that high ethical behavior goes beyond the principles addressed in this topic. When encountering a situation not specifically outlined in the Code, Members are always expected to act in an ethical fashion. Acting with prudence in all situations related to the profession will uphold the integrity of the risk management field as well as risk management practitioners.

THE CODE OF CONDUCT[1]

The Code of Conduct stresses ethical behavior in two areas: (1) Principles and (2) Professional Standards. The Principles section addresses: (1) professional integrity and ethical conduct, (2) conflicts of interest, and (3) confidentiality. The Professional Standards section addresses: (1) fundamental responsibilities and (2) adherence to generally accepted practices in risk management. The responsibilities listed in each section are examined in the following LO.

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LO 14.1: Describe the responsibility of each GARP member with respect to professional integrity, ethical conduct, conflicts of interest, confidentiality of information and adherence to generally accepted practices in risk management.

1. Professional Integrity and Ethical Conduct

GARP Members:

1.1. shall act professionally, ethically and with integrity in all dealings with employers, existing or potential clients, the public, and other practitioners in the financial services industry.

1.2. shall exercise reasonable judgment in the provision of risk services while maintaining independence of thought and direction. GARP Members must not offer, solicit, or accept any gift, benefit, compensation, or consideration that could be reasonably expected to compromise their own or another's independence and objectivity.

1.3. must take reasonable precautions to ensure that the Member's services are not used for improper, fraudulent or illegal purposes.

1.4. shall not knowingly misrepresent details relating to analysis, recommendations, actions, or other professional activities.

1.5. shall not engage in any professional conduct involving dishonesty or deception or engage in any act that reflects negatively on their integrity, character, trustworthiness, or professional ability or on the risk management profession.

1.6. shall not engage in any conduct or commit any act that compromises the integrity of GARP, the FRM® designation, or the integrity or validity of the examinations leading to the award of the right to use the FRM designation or any other credentials that may be offered by GARP.

1.7. shall be mindful of cultural differences regarding ethical behavior and customs, and avoid any actions that are, or may have the appearance of being unethical according to local customs. If there appears to be a conflict or overlap of standards, the GARP Member should always seek to apply the highest standard.

2. Conflict of Interest

GARP Members shall:

2.1. act fairly in all situations and must fully disclose any actual or potential conflict to all affected parties.

2.2. make full and fair disclosure of all matters that could reasonably be expected to impair independence and objectivity or interfere with respective duties to their employer, clients, and prospective clients.

3. Confidentiality

GARP Members:

3.1. shall not make use of confidential information for inappropriate purposes and unless having received prior consent shall maintain the confidentiality of their work, their employer or client.

3.2. must not use confidential information for personal benefit.

4. Fundamental Responsibilities

GARP Members shall:

4.1. comply with all applicable laws, rules, and regulations (including this Code) governing the GARP Members' professional activities and shall not knowingly participate or assist in any violation of such laws, rules, or regulations.

4.2. have ethical responsibilities and cannot outsource or delegate those responsibilities to others.

4.3. understand the needs and complexity of their employer or client, and should provide appropriate and suitable risk management services and advice.

4.4. be diligent about not overstating the accuracy or certainty of results or conclusions.

4.5. clearly disclose the relevant limits of their specific knowledge and expertise concerning risk assessment, industry practices, and applicable laws and regulations.

5. Best Practices

GARP Members shall:

5.1. execute all services with diligence and perform all work in a manner that is independent from interested parties. GARP Members should collect, analyze and distribute risk information with the highest level of professional objectivity.

5.2. be familiar with current generally accepted risk management practices and shall clearly indicate any departure from their use.

5.3. ensure that communications include factual data and do not contain false information.

5.4. make a distinction between fact and opinion in the presentation of analysis and recommendations.

VIOLATIONS OF THE CODE OF CONDUCT

LO 14.2: Describe the potential consequences of violating the GARP Code of Conduct.

All GARP Members are expected to act in accordance with the GARP Code of Conduct as well as any local laws and regulations that pertain to the risk management profession. If the Code and certain laws conflict, then laws and regulations will take priority.

Violations of the Code of Conduct may result in temporary suspension or permanent removal from GARP membership. In addition, violations could lead to a revocation of the right to use the FRM designation. Sanctions would be issued after a formal investigation is conducted by GARP.

Professor's Note: There are no Key Concepts for this short topic.

CONCEPT CHECKERS

1. Over the past two days, Lorraine Quigley, FRM, manager of a hedge fund, has been purchasing large quantities of Craeger Industrial Products' common stock while at the same time shorting put options on the same stock. Quigley did not notify her clients of the trades although they are aware of the fund's general strategy to generate returns. Which of the following statements is most likely correct? Quigley:
   A. did not violate the Code.
   B. violated the Code by manipulating the prices of publicly traded securities.
   C. violated the Code by failing to disclose the transactions to clients before they occurred.
   D. violated the Code by failing to establish a reasonable and adequate basis before making the trades.

2. Jack Schleifer, FRM, is an analyst for Brown Investment Managers (BIM). Schleifer has recently accepted an invitation to visit the facilities of ChemCo, a producer of chemical compounds used in a variety of industries. ChemCo offers to pay for Schleifer's accommodations in a penthouse suite at a luxury hotel and allow Schleifer to use the firm's private jet to travel to its three facilities located in New York, Hong Kong, and London. In addition, ChemCo offers two tickets to a formal high-society dinner in New York. Schleifer declines to use ChemCo's corporate jet or to allow the firm to pay for his accommodations but accepts the tickets to the dinner (which he discloses to his employer) since he will be able to market his firm's mutual funds to other guests at the dinner. Has Schleifer violated the GARP Code of Conduct?
   A. Yes.
   B. No, since he is using the gifts accepted to benefit his employer's interests.
   C. No, since the gifts he accepted were fully disclosed in writing to his employer.
   D. No, since the gift he accepted is of nominal value and he declined to accept the hotel accommodations and the use of ChemCo's jet.

3. Beth Bixby, FRM, oversees a mid-cap fund that is required to invest in a minimum of 40 and a maximum of 60 different issues. Bixby uses a quantitative approach to actively manage the assets. In promotional materials, she states that "through our complex quantitative approach, securities are selected that have similar exposures to a number of risk factors that are found in the S&P 500 Index. Thus the fund is designed to track the performance of the S&P 500 Index but will receive a return premium of between 2% and 4% according to our model's risk-return measures." This statement is:
   A. permissible since the assertion is supported by modern portfolio theory and estimates from the firms' model.
   B. not permissible since Bixby is misrepresenting the services that she and/or her firm are capable of performing.
   C. not permissible since Bixby is misrepresenting the investment performance she and/or her firm can reasonably expect to achieve.
   D. permissible since the statement describes the basic characteristics of the fund's risk and return objectives.

4. Gail Stefano, FRM, an analyst for a U.S. brokerage firm that serves U.S. investors, researches public utilities in South American emerging markets. Stefano makes the following statement in a recent report: "Based on the fact that the South American utilities sector has seen rapid growth in new service orders, we expect that most companies in the sector will be able to convert the revenue increases into significant profits. We also believe the trend will continue for the next three to five years." The report goes on to describe the major risks of investing in this market, in particular the political and exchange rate instability associated with South American countries. Stefano's report:
   A. has not violated the Code.
   B. violated the Code by failing to properly distinguish factual information from opinions.
   C. violated the Code by recommending an investment which would not be suitable for all of its clients.
   D. violated the Code by failing to properly identify details related to the operations of South American utilities.

5. Beth Anderson, FRM, is a portfolio manager for several wealthy clients including Reuben Carlyle. Anderson manages Carlyle's personal portfolio of stock and bond investments. Carlyle recently told Anderson that he is under investigation by the IRS for tax evasion related to his business, Carlyle Concrete (CC). After learning about the investigation, Anderson proceeds to inform a friend at a local investment bank so that they may withdraw their proposal to take CC public. Which of the following is most likely correct? Anderson:
   A. violated the Code by failing to immediately terminate the client relationship with Carlyle.
   B. violated the Code by failing to maintain the confidentiality of her client's information.
   C. violated the Code by failing to detect and report the tax evasion to the proper authorities.
   D. did not violate the Code since the information she conveyed pertained to illegal activities on the part of her client.

CONCEPT CHECKER ANSWERS

1. **A** Quigley's trades are most likely an attempt to take advantage of an arbitrage opportunity that exists between Craeger's common stock and its put options. She is not manipulating the prices of securities in an attempt to mislead market participants. She is pursuing a legitimate investment strategy. Participants in her hedge fund are aware of the fund's investment strategy, and thus Quigley did not violate the Code by not disclosing this specific set of trades in advance of trading (Standards 2.1 and 5.1).

2. **A** GARP Members must not offer, solicit, or accept any gift, benefit, compensation, or consideration that could be reasonably expected to compromise their own or another's independence and objectivity. Schleifer has appropriately rejected the offer of the hotel accommodations and the use of ChemCo's jet. However, Schleifer cannot accept the tickets to the dinner. Since it is a formal high-society dinner, the tickets are most likely expensive or hard to come by. Even though he has disclosed the gift to his employer and he plans to use the dinner as a marketing opportunity for his firm, the gift itself may influence Schliefer's future research in favor of ChemCo. Allowing such potential influence is a violation of Professional Integrity and Ethical Conduct (Standard 1.2).

3. **C** It is not reasonable for Bixby to expect a 40-to-60 stock mid-cap portfolio to track the entire S&P 500 Index, which is a large-cap index. She should know that there will be periods of wide variance between the performance of the portfolio and the S&P 500 Index. There is no assurance that a premium of 2% to 4% will consistently be obtained. Bixby is in violation of Standard 1.4: "GARP Members shall not knowingly misrepresent details relating to analysis, recommendations, actions, or other professional activities," since she has made an implicit guarantee of the fund's expected performance.

4. **A** Historical growth can be cited as a fact since it actually happened. Stefano states that her firm expects further growth and profitability which is an opinion. She does not claim that these are facts. Thus, she is not in violation of Standard 5.4. In addition, Stefano identifies relevant factors and highlights in particular the most significant risks of investing in South American utilities. She has fully complied with Standard 5.3.

5. **B** Anderson must maintain the confidentiality of client information according to Standard 3.1. Confidentiality may be broken in instances involving illegal activities on the part of the client, but the client's information may only be relayed to proper authorities. Anderson did not have the right to inform the investment bank of her client's investigation.

SELF-TEST: FOUNDATIONS OF RISK MANAGEMENT

10 Questions: 24 Minutes

1. A firm has determined that the value at risk (VaR) of its investment portfolio is $18 million for one day at a 95% confidence level. Which of the following statements regarding this VaR measure is correct?
   A. There is a 95% probability that the portfolio will lose $18 million on a given day.
   B. There is a 95% probability that the portfolio will lose no more than $18 million on a given day.
   C. There is a 5% probability that the portfolio will lose $18 million on a given day.
   D. There is a 5% probability that the portfolio will lose no more than $18 million on a given day.

2. A risk management consultant is considering the feasibility of hedging several risk exposures at Firm XYZ. Regarding the advantages and disadvantages of hedging risk exposures in practice, which of the following actions will least likely result from hedging activities for the firm?
   A. Lower cost of equity capital.
   B. Operational improvements.
   C. Lower cost of debt capital.
   D. Lower compliance costs.

3. Over a decade ago, Yasuo Hamanaka, the lead copper trader for Sumitomo, attempted to corner the copper market in a classic market manipulation strategy. Such lack of supervision over his trading activities resulted from poor internal controls. Because of that lack of supervision, which of the following series of transactions was he able to engage in that ultimately resulted in a $2.6 billion trading loss for Sumitomo?
   A. Long physical copper, short futures contracts, bought put options.
   B. Short physical copper, long futures contracts, sold put options.
   C. Long physical copper, long futures contracts, sold put options.
   D. Short physical copper, short futures contracts, bought put options.

4. In 1976, Drysdale Securities was able to borrow $300 million in unsecured funds from Chase Manhattan Bank. Drysdale used the borrowed funds to take bond positions, which eventually declined in value. Given the loss in market value, Drysdale was unable to repay the borrowed funds and was forced into bankruptcy. Which firm was to blame for this financial disaster?
   I. Drysdale Securities
   II. Chase Manhattan

   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

5. Risk metrics aid the management process by providing managers a target to achieve (e.g., a particular VaR level). Monitoring these risk metrics allows managers to appropriately manage risk. However, risk metrics may be too narrow in scope, which can make it more difficult to achieve the overall objective of managing risk in an effort to create value. Which of the following statements represents a shortcoming/misuse of VaR?
   I. VaR assumes the distributions of losses are correlated over time.
   II. Choosing a VaR time horizon that does not correspond to the liquidity of the assets in the portfolio will likely lead to risk mismeasurement.
   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

6. An analyst has estimated that the returns for an asset, conditional on the performance of the overall economy, are:

Return	*Probability*	*Economic Growth*
5%	20%	Poor
10%	40%	Average
14%	40%	Good

Also, the conditional expected returns on the market portfolio are:

Return	*Probability*	*Economic Growth*
2%	20%	Poor
10%	40%	Average
15%	40%	Good

According to the CAPM, if the risk-free rate is 5% and the risky asset has a beta of 1.1, with respect to the market portfolio, the analyst should:
   A. sell (or sell short) the risky asset because its expected return is less than equilibrium expected return on the market portfolio.
   B. buy the risky asset because the analyst expects the return on it to be higher than its required return in equilibrium.
   C. sell (or sell short) the risky asset because its expected return is not sufficient to compensate for its systematic risk.
   D. buy the risky asset because the analyst expects the return on it to be lower than its required return in equilibrium.

7. Chrome Fund has an expected return of 12%. Nickel Fund is expected to provide an excess return of 8%. Standard deviations of returns are 5% for Chrome Fund and 4% for Nickel Fund. The risk-free rate is 2%. Based on the Sharpe ratio, a rational investor should:
   A. prefer Chrome Fund to Nickel Fund.
   B. prefer Nickel Fund to Chrome Fund.
   C. be indifferent between Chrome Fund and Nickel Fund.
   D. not invest in either Chrome Fund or Nickel Fund.

8. A portfolio manager employs a 2-factor APT model to calculate expected returns for Portfolio P. The two factors are percentage changes in GDP and changes in the term structure of interest rates, defined as the difference between yields in 30-year Treasury bonds and 1-year Treasury bills. Assume the following data:

Risk-free rate = 4%
GDP factor beta = 2.00
Term structure factor beta = 0.50
GDP risk premium = 6%
Term structure risk premium = 5%

Using the 2-factor APT model for Portfolio P, which of the following expected returns is correct?
A. 8.5%.
B. 12.5%.
C. 14.5%.
D. 18.5%.

9. Alan Walters is a risk manager at OneFirst Bank. He has recently been asked to prepare a risk management report for his bank's board of directors. The board members are planning to utilize this report to make critical risk management decisions regarding relevant bank risks. Walters assures the board that the report will be accurate and complete by covering all material risk areas within the organization. He also points out that the report will contain meaningful information that will be applicable to all employees and easily understood at all levels of the organization. Walters plans on distributing the risk management report to all relevant parties while ensuring confidentiality. Which of the following effective risk data aggregation and risk reporting principles set forth by the Basel Committee on Banking Supervision did Walters most likely violate?
A. Principle 7—Accuracy.
B. Principle 8—Comprehensiveness.
C. Principle 9—Clarity and Usefulness.
D. Principle 11—Distribution.

10. Will Lambert, FRM, is a financial risk analyst for Offshore Investments. He is preparing a purchase recommendation on Burch Corporation. According to the GARP Code of Conduct, which of the following statements about disclosure of conflicts is most correct? Lambert would have to disclose that:
A. his wife owns 2,000 shares of Burch Corporation.
B. Offshore is an over-the-counter market maker for Burch Corporation's stock.
C. he has a material beneficial ownership of Burch Corporation through a family trust.
D. All of these choices require disclosure.

SELF-TEST ANSWERS: FOUNDATIONS OF RISK MANAGEMENT

1. **B** The VaR of this investment can be interpreted as either (1) there is a 95% probability that the portfolio will lose no more than $18 million on a given day or (2) there is a 5% probability that the portfolio will lose more than $18 million on a given day.

   (See Topic 1)

2. **D** Hedging activities incur compliance costs related to disclosure and accounting.

   (See Topic 2)

3. **C** Hamanaka established a dominant long position in futures contracts and simultaneously purchased large quantities of physical copper. As well, to help finance his long copper positions, he even sold put options on copper. In essence, here was a "triple long" strategy that would only pay off if the price of copper or copper futures increased. At the same time, there was a huge risk of losses should the prices fall. Unfortunately, there was a continuation of plummeting copper prices after other copper traders began selling their copper holdings in anticipation of Sumitomo doing the same. The end result was total losses of $2.6 billion for Sumitomo.

   (See Topic 6)

4. **C** Clearly, misleading reporting was used by Drysdale in order to obtain the borrowed funds. However, Chase Manhattan was partially to blame for assuming that it was simply the middleman in the transactions and the positions taken had a low level of risk. The inexperienced managers at Chase failed to realize that the contract wording with Drysdale indicated that Chase would be held responsible for any payments due.

   (See Topic 6)

5. **B** One misuse of VaR is choosing a time period (e.g., daily or weekly) that does not correspond to the liquidity of the assets in the portfolio. Using daily VaR on a portfolio where the assets cannot be effectively traded within a day is clearly not appropriate. Taking a longer term horizon to account for liquidity of the assets may not be sufficient either. VaR assumes the distributions of losses are *not* correlated over time, so Statement I is incorrect. A crisis can change the nature of a return distribution for a given period as well as across periods.

   (See Topic 9)

6. **C** The analyst's forecast of the expected return on the risky asset is 5(0.2) + 10(0.4) + 14(0.4) = 10.6%. The expected/equilibrium return on the market portfolio is 2(0.2) + 10(0.4) + 15(0.4) = 10.4%.

   The CAPM equilibrium expected return (required return in equilibrium) on the risky asset is 5 + 1.1(10.4 – 5) = 10.94%. Since the analyst's forecast return on the risky asset is less than its required return in equilibrium, the asset is overpriced and the analyst would sell if he owned it and possibly sell it short.

   (See Topic 10)

7. **C** Excess return for Chrome is 12% – 2% = 10%. Chrome's Sharpe ratio is 10% / 5% = 2.0. Excess return for Nickel is given as 8%. Nickel's Sharpe ratio is 8% / 4% = 2.0. An investor should be indifferent between these two funds because they provide the same expected excess return per unit of risk.

   (See Topic 11)

8. **B** Record level consistency is consistency between one set of data values and another set within the same record. Temporal level consistency is consistency between one set of data values and another set within the same record at different points in time.

   (See Topic 12)

9. **C** Principle 9 requires that reports be tailored to the end user (e.g., the board, senior managers, and risk committee members) and should assist them with sound risk management and decision making. Walters suggested that the report would not be tailored to the board because the report was going to be applicable to all employees and easily understood at all levels of the organization. Principle 7 requires that risk reports should be accurate and precise. Board members should be able to use the reports to make critical decisions about bank risks. Principle 8 requires that reports should contain position and risk exposure information for all relevant risks. Principle 11 requires that reports should be disseminated in a timely fashion while maintaining confidentiality where required.

   (See Topic 13)

10. **D** According to Standard 2.2, GARP Members shall make full and fair disclosure of all matters that could reasonably be expected to impair independence and objectivity or interfere with respective duties to their employer, clients, and prospective clients.

    (See Topic 14)

FORMULAS

Topic 10

$$\text{Beta}_i = \frac{\text{Cov}(R_i, R_M)}{\sigma_M^2}$$

capital asset pricing model: $E(R_i) = R_F + \text{Beta}_i[E(R_M) - R_F]$

capital market line: $E(R_P) = R_F + \left[\frac{E(R_M) - R_F}{\sigma_M}\right]\sigma_P$

Topic 11

Treynor measure: $\left[\frac{E(R_P) - R_F}{\beta_P}\right]$

Sharpe measure: $\left[\frac{E(R_P) - R_F}{\sigma_P}\right]$

Jensen's alpha: $\alpha_P = E(R_P) - R_F - [E(R_M) - R_F]\beta_P$

Sortino ratio: $\frac{E(R_P) - R_{min}}{\sqrt{MSD_{min}}}$

information ratio $= \left[\frac{E(R_P) - E(R_B)}{\sigma_{e_P}}\right] = \frac{\alpha_P}{\sigma_{e_P}}$

Topic 12

multifactor model: $R_i = E(R_i) + \beta_{i1}F_1 + \beta_{i2}F_2 + \ldots + \beta_{ik}F_k + e_i$

where:
R_i = return on stock *i*
$E(R_i)$ = expected return for stock *i*
β_{ij} = *j*th factor beta for stock *i*
F_j = deviation of macroeconomic factor *j* from its expected value
e_i = firm-specific return for stock *i*

APT model: $E(R_i) = R_F + \beta_{i1}[E(R_1) - R_F] + \beta_{i2}[E(R_2) - R_F] + \ldots + \beta_{ik}[E(R_k) - R_F]$

Fama-French three-factor model:

$$R_i - R_F = \alpha_i + \beta_{i,M}(R_M - R_F) + \beta_{i,SMB}SMB + \beta_{i,HML}HML + e_i$$

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